HONORS PROJECT

3-Dimensional Computer Graphics to Assess The Aesthetics of Forest Clearcutting Blocks

For partial fulfillment of the requirements for the degree, Bachelor of Science with Distinction.

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ABSTRACT

The Surface II computer graphics program is used to generate stereoscopic representations of a forest stand that can be viewed in 3-dimensions. Any number of forest clearcuts can be inserted into the drawings which can be viewed from any vantage point outside the forest stand. Sample drawings depicting the Barnaby Center near Lancaster, Ohio, as it might be viewed from various angles and elevations are included to demonstrate the applicability of this system to the field of Forestry.

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Blondie

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PROBLEM STATEMENT

The purpose of this study will be to incorporate the Surface II computer program to develop a system to illustrate the impact of forest clearcuts on the aesthetic quality of a forest.

Aesthetic quality is one of the most important problems facing forest managers today. Since people tend to judge forest management practices by their immediate visual effects it is important to take these effects into account when managing a forest area (Wagar, 1977).

Using Surface II, a pair of isometric drawings of a proposed clearcut can be constructed. These drawings can then be viewed in stereo and the forest manager will be better able to evaluate the visual effects that such a clearcut would have on the aesthetic quality of the forest.

OBJECTIVES

1. Collect topographic and forest stand height data from a sample area of the Barnaby Center and transfer it to the Surface II computer program.
2. Using Surface II, generate a graphic representation of the area in three dimensional form.
3. Select sample areas of the Barnaby Center as potential clearcut sites and transform the computerized data to represent these clearcuts.
4. Evaluate the isometric drawings with and without the clearcut areas for their ability to accurately represent actual clearcuts.
5. Develop a step-by-step system that can be used to investigate the aesthetic effects of clearcuts on any forest area.

Literature Review

Clearcutting a forest area produces a radical change in the visual quality of the area. Why use clearcuts as a method to harvest the forest? In his book "The Practice of Silviculture" David Smith (1962) lists several situations in forest silviculture where clearcutting, as a method of harvest and reproduction, is the best method available. For instance, if the trees not to be harvested don't have any further value, clearcutting is advised. Also in a thoroughly mature or overmature stand, clearcutting is preferred.

Clearcutting is not only a valid silvicultural method but also an economically important and widely used one.

"Timber Harvesting and Aesthetic Quality" was the subject of Technical Session A at the Society of American Foresters 1977 National Convention. In an article entitled "New Techniques for Coordinating Timber Harvesting and Esthetic Values", Gary Elsner (1977) describes various approaches to achieving a balance between economic and aesthetic values in timber harvesting.

Three of the computer graphic techniques described are "Perspective View" developed by Roger Twito and John Warner, "Scope" developed by Devon Nickerson, and "Preview" developed by Erik Myklestad and J. Alan Wagar. "Perspective View" generates "as seen" drawings using a desk top computer, a digitizer, and a plotter. The resulting drawings give a two-dimensional representation of an area and plot individual trees on the borders of proposed cuts. "Scope" and "Preview" are used to visualize various types of partial cuts.

The "Perspective View" program is explained in more detail with example illustrations in an article entitled "Plotting Landscape Perspectives with Desk-Top Computers" by Roger H. Twito (1977). This article is also found in the proceedings of the 1977 S.A.F. National Convention.

Another system used to portray landscape alterations is the "MOSAIC" system developed by the U.S. Forest Service. This system is capable of superimposing landscape changes in color photographs to create a photo montage. These graphic displays are also two-dimensional representations. This system is explained in the article "A Computerized System for Portrayal of Landscape Alterations" by A.E. Stevenson, J.A. Conley, and J.B. Carey (1979), which was presented in the Proceedings of "Our National Landscape--A Conference on Applied Techniques for Analysis and Management of the Visual Resource" held April 23-25, 1979.

The programs mentioned above represent various degrees of complexity and cost. They are limited to two-dimensional displays and are simple black and white computer pen drawings or a complex photo montage such as that created by the "MOSAIC" system.

Surface II, with its ability to present a graphic display that can be viewed in three dimensions should carry the concept of graphic representation one-step further without going through the time and expense of creating an acutal 3-dimensional model of the proposed area. This study will attempt to outline and evaluate a method of using the Surface II graphics program that will generate such a model on paper.

Methodology

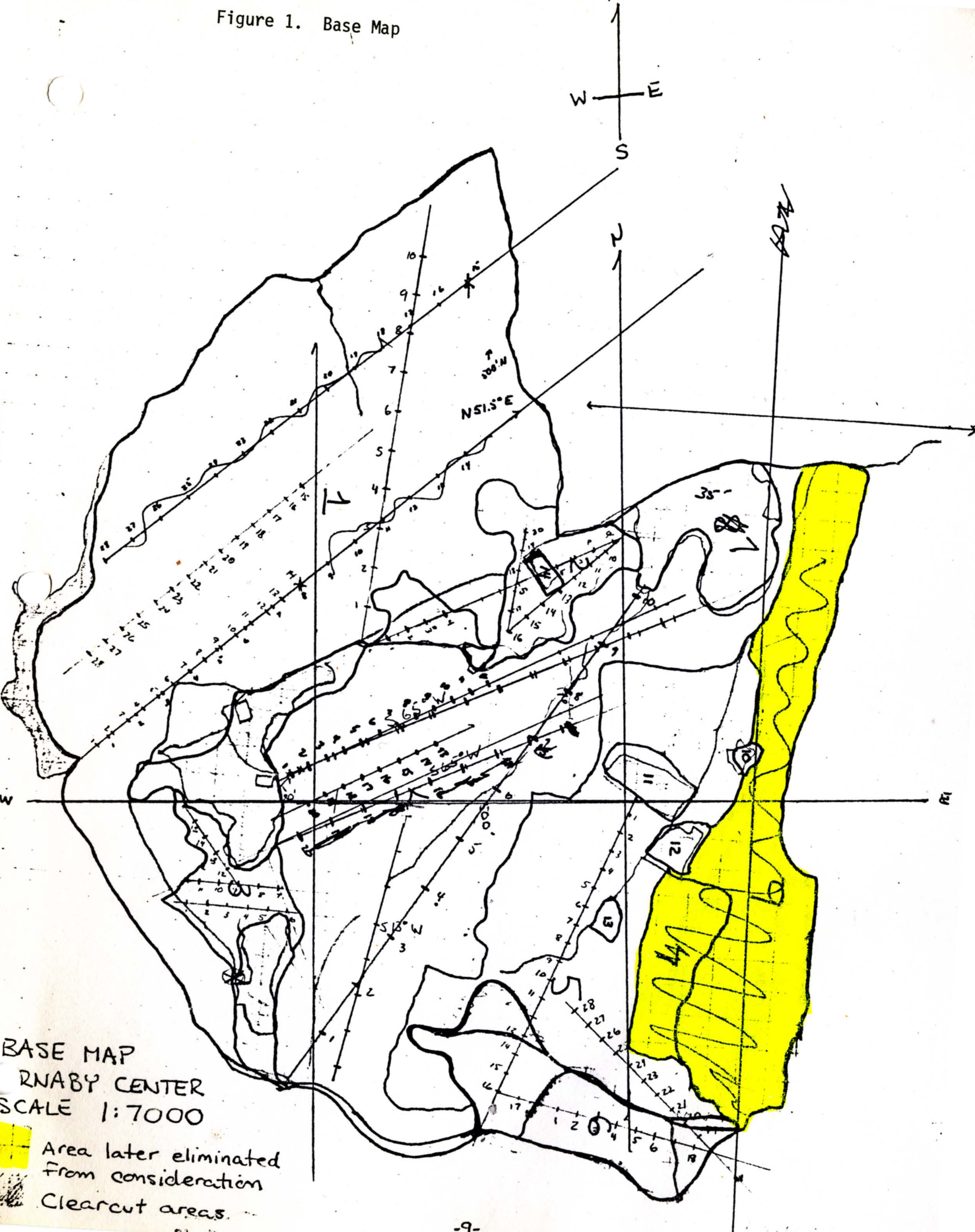
Once an area has been selected for study, the first step in the process is to draw a base map of the area (See Figure 1). Any geographic features should be drawn on the map to provide reference points for later comparisons. Streams, rivers, roads, buildings, and clearings are examples of helpful landmarks.

When selecting the boundaries of the area to be studied, it is advisable to make them as close to a rectangle as possible. When the Surface II program generates a drawing of the area, it is drawn as a block or rectangle. Any irregular boundaries will be enclosed in a block with areas outside the boundaries being drawn at a base value, usually the lowest Z value in the data set.

After the base map has been sketched out, a pair of stereo aerial photos are required. These photos should be small enough in scale so that tree heights and stand density can be interpreted from them (Figure 2). Using a zoom transfer scope or a similar transfer device, the boundaries of the base map are drawn onto one of the photos. If the boundaries form a rectangle, it may not be necessary to use the transfer device at this point, but it will be useful at a later stage. By using the zoom transfer scope, the reference points on the base map can be lined up with the actual features on the photograph.

Next, by examining the stereo pair through a steroscope, the study area should be differentiated into smaller areas of equal height and density. Actually, density doesn't have much effect on the final product, except in cases where there are only a few large trees scattered throughout an area. It is not necessary to insure that the boundaries of these stands or areas are

Figure 1. Base Map



BASE MAP
(RNABY CENTER
SCALE 1:7000

Area later eliminated from consideration

Clearcut areas.

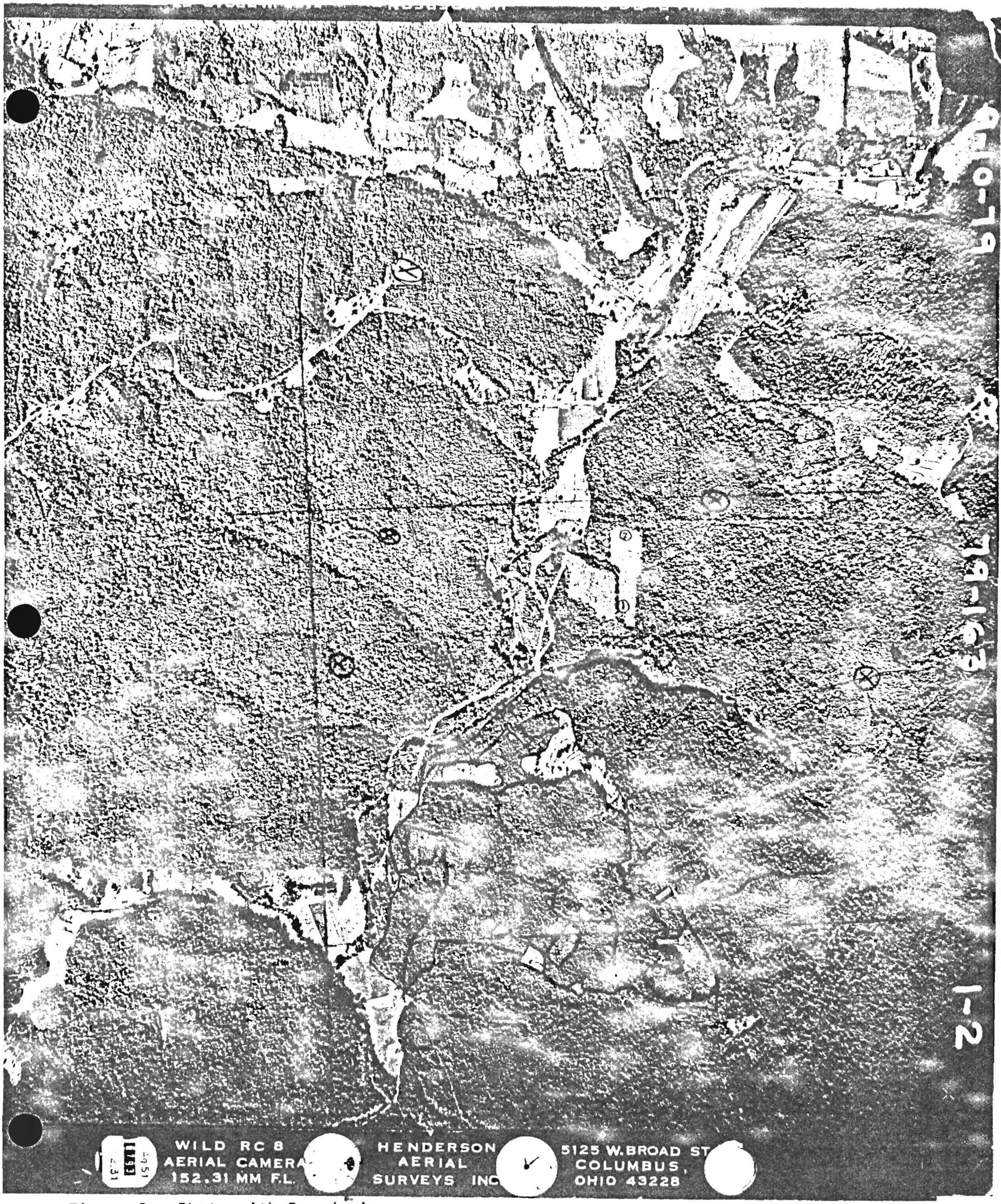


Figure 2. Photo with Boundaries

rectangular. When differentiating between two areas, it should be remembered that the tree heights usually increase as the trees are further down into a draw or depression. This will not always be detectable on the photos but it is important because, if not accounted for, the draws will appear more severe on the drawing than in actuality.

The boundaries of all the areas are then transferred to the base map. We now have a base map with the different stands delineated on it and an aerial photo with the same information on it (Figure 1).

The next step is to use some method to sample the tree heights in each different stand or area on the base map. The sample should be a random ~~one~~ with enough ~~sample~~ points in each area to give a statistically valid average tree height. For the six areas used in this study, the number of sample points ranged from 38 to as few as 10. The coefficient of variation was never more than 28% for any area.

One method of taking these random samples is to randomly drop a line on the area and then mark off points every X feet. Depending on the size of the area being sampled, distances between points might be 50, 100, 200, or 300 feet. By laying down two or three different lines in random directions, a fairly good cross section of the area can be sampled. This results in two or three random systematic line-plot samples. Since the make-up of the heights of the trees are assumed not to follow a systematic pattern coinciding with the line-plots, it is traditional to treat each plot on the line as an independent random sample. When all lines and points have been drawn on the base map, field measurements can begin.

The measurement tools required are some type of hypsometer or altimeter, a compass, and a 100 foot tape meaure. In the event that tree height data is available for the study area, this entire step is unnecessary, which makes the whole process quite a bit easier and much less time consuming. However, in cases where tree height data is not available, it must be measured. Following the compass lines drawn on the base map, sample tree heights are measured at each point along the line. The measurements are made most quickly with three people on a crew. One person handles the compass and guides a second person who walks about the required distance to the next sample point. When he is about the right distance away, the compass person moves him left or right until he is in line. He may not move the whole distance at one time if the forest is very dense. Next the third person takes the tape measure and walks forward with the tape to measure of the distance to the next point. If pacing is used instead, the third person is not necessary.

At each sample point, one crew member selects a tree as close as possible that is either a dominant or co-dominant. He then measures the correct distance from the base of the tree and measures the tree height with the hypsometer. The tree height, tree species, and sample number should be recorded for each sample point.

After all the sample points have been measured for the entire study area, the next step is to calculate the average tree height and the standard deviation for each of the different stands or strata. The coefficient of variation should also be calculated to see how much variation exists within each stratum, so that if too much variation is present, more sample points can be measured. After completing these calculations, the average tree height and standard deviation for each stratum should be listed for calculations in a later step. This data will be used to generate random tree heights for each stratum, but first another map must be prepared.

For this map, a 1:24,000 scale topographic map is used (Figure 3). Using the zoom transfer scope and either the base map or the aerial photograph

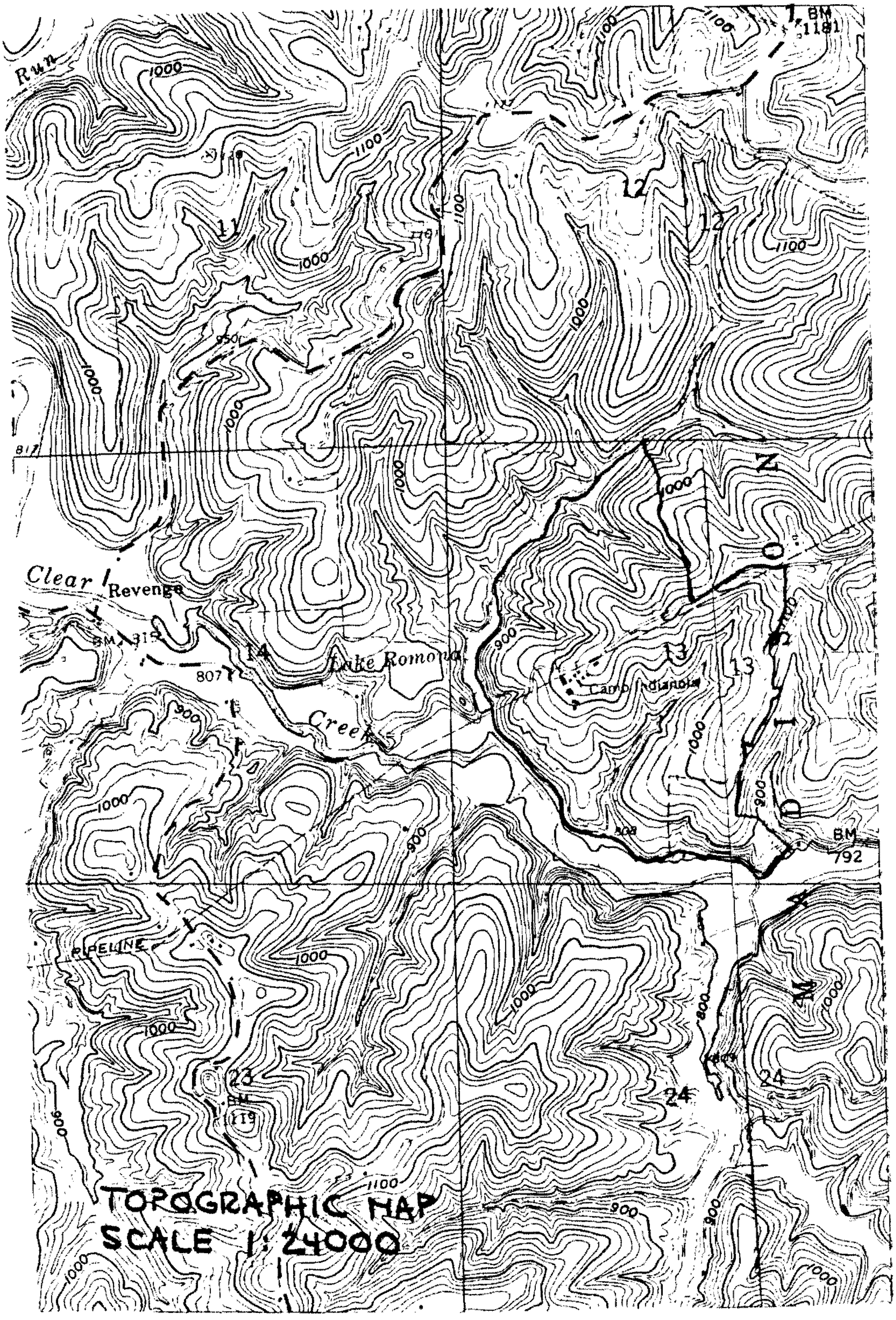


Figure 3. Topographic Map

with the boundaries on it, these boundaries should be transfered to the topo map. Then, the area of the map containing the study area should be enlarged either by using a good quality copier, or by photographing the area and having the photograph enlarged to a usable size.

For the area studied in this example, enlarging the area to a 1:10,000 scale produced a workable size map (Figure 4).

Once all of the boundary lines have been transferred to the enlarged topographic map, a grid should be superimposed on the map in a random manner. The grid can either be purchased, or made by photocopying a piece of graph paper onto a transparency. The number of grid intersections falling within the boundaries of the study area will be the number of data points used to generate the finished drawings. The more points used, the better the drawings will be in terms of quality. However, using more data points also requires more time, so there will be a point where there is a balance. For finished drawings of eight inches in the widest direction, such as those made in this example, a grid with five squares to the inch provides an acceptable number of data points (approximately 600). With the grid transparency attached to the enlarged topo map, photocopies can be made which will be a copy of the topo map with the grid superimposed on it (Figure 5).

Next, grid coordinates should be listed on the grid map with the origin in the lower left hand corner or the southwest corner of the map. Then by following the X and Y lines to an intersection of the two, a grid pair can be determined for each intersection on the map. The grid pairs are then listed on paper by X and Y coordinates. For each grid pair listed, the ground elevation should be noted by examing the elevation contours on the grid map. This elevation will provide the height of the forest floor when the drawings are produced. A finished list of all data points at this step will contain

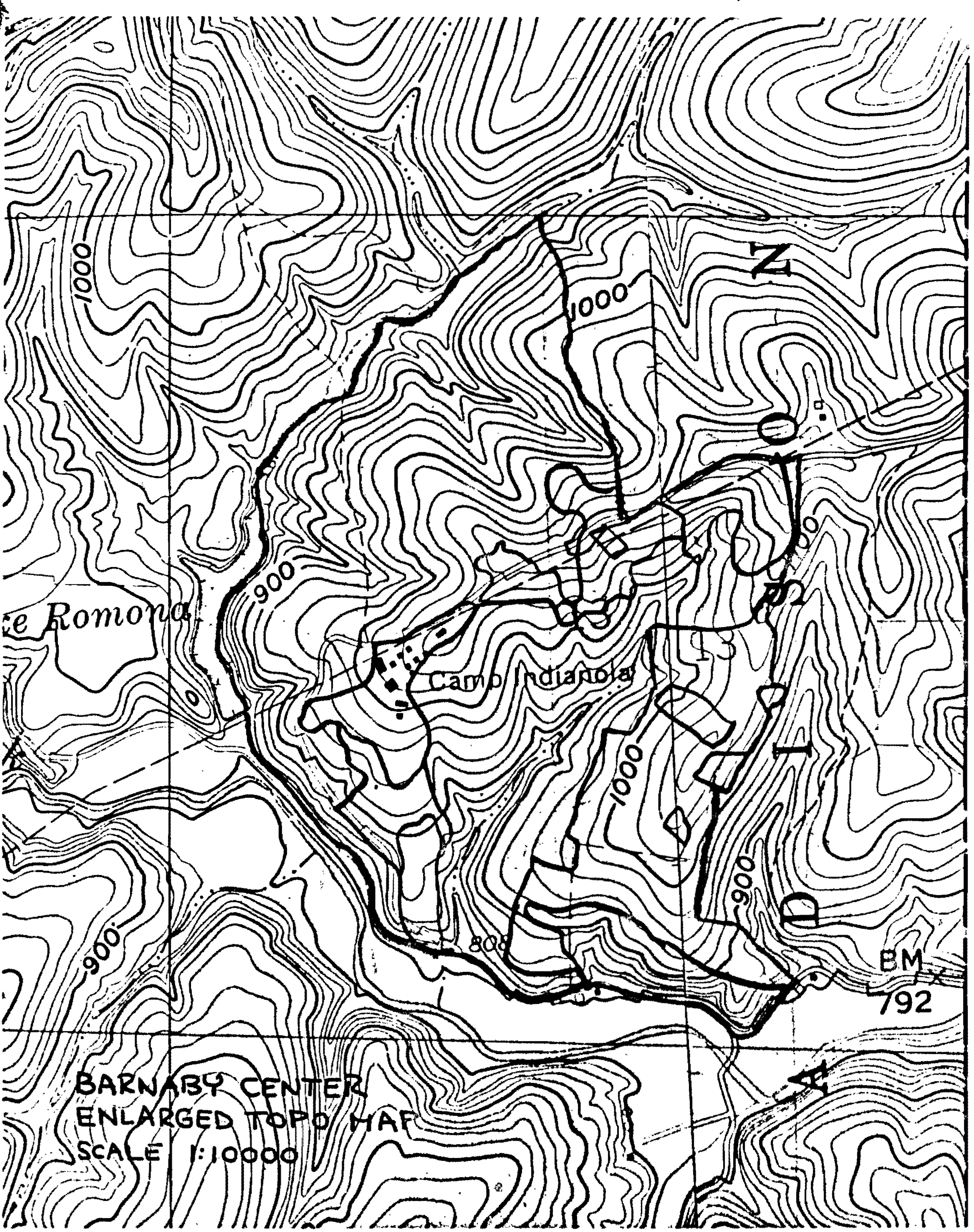


Figure 4. Enlarged Topographic Map

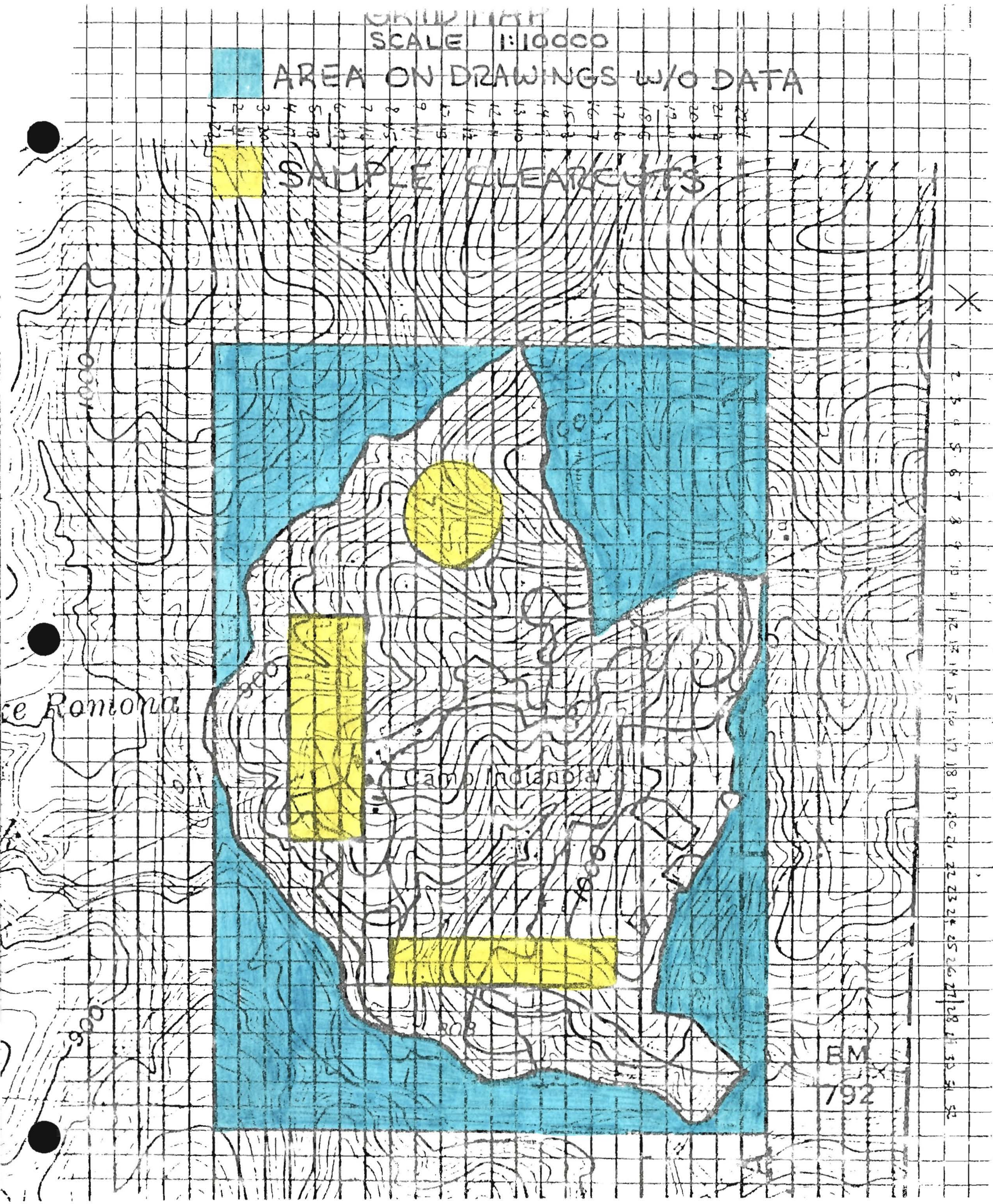


Figure 5. Grid Map

X values in grid elements, Y values, also in grid elements, and Z values, in feet. Each data point should also include the number identifying which stratum the point occurs in. In the example produced here, there are six different strata, so each data point will have a number from 1 to 6 to identify its loaction within the study area. This Z value will be called the Z_2 value. The Z_1 value will represent the sum of the Z_2 value and the canopy height for that particular data point. Now, the Z_1 values for each data point must be calculated, using the average tree height and standard deviation from each of the strata in the sample.

A random number table that has a normal distribution with a mean of 0 and a standard deviation of 1 will be used to take the average tree height and the standard deviation for each area and generate a series of random tree heights that vary around the average assuming a normal distribution of tree heights for that particular stratum. This process is easily performed on a programmable calculator.

See Figure 6 for the acutal procedure to generate these tree heights on a T.I.-56 pocket calculator. The process is repeated for all data points, yielding a representative canopy height for the entire study area. The tree heights are added to the Z_2 values, which is the ground elevation, to obtain the Z_1 values which can then be listed with the other three values for each data point. With the resulting list of four values for each data point in the study area, the data can be entered into the computer program and the finished drawings generated. Figure 7 is a list of the data points and their corresponding values for the example study area.

Figure 8 is the computer program used to generate the drawings for this example study area. Lines 1 through 5 constitute the Job Control Language (J.C.L.) and stay the same for all the drawings. Lines 19 and 20 are also

TI-56--Calculator Program Listing for
Generating Random Tree Heights

First, store the standard deviation in register 2 and the average tree height in register 3.

Next enter the program by punching the following buttons:

LRN
X
RCL
2
=
+
RCL
3
=
R/S
RST
R/S
LRN
RST

Then, for the operation, enter each random number from the table followed by the R/S key.
The resulting figures will be random tree heights for each area.

Figure 6 - Calculator Procedure

Figure 7. List of Data Points

1.	13.	935.	850.
2.	13.	983.	895.
2.	12.	921.	855.
3.	14.	1061.	960.
3.	13.	1005.	925.
3.	12.	961.	885.
3.	11.	943.	855.
3.	10.	935.	845.
4.	14.	1083.	985.
4.	13.	1073.	960.
4.	12.	998.	935.
4.	11.	988.	900.
4.	10.	959.	855.
5.	14.	1079.	1010.
5.	13.	1086.	995.
5.	12.	1060.	975.
5.	11.	1031.	940.
5.	10.	1003.	885.
5.	9.	938.	850.
5.	8.	923.	850.
5.	7.	942.	840.
6.	14.	1111.	1020.
6.	13.	1088.	1005.
6.	12.	1057.	980.
6.	11.	1021.	945.
6.	10.	988.	890.
6.	9.	976.	885.
6.	8.	931.	865.
6.	7.	932.	845.
7.	14.	1130.	1010.
7.	13.	1042.	985.
7.	12.	1031.	950.
7.	11.	1008.	910.
7.	10.	983.	885.
7.	9.	986.	885.
7.	8.	1008.	920.
7.	7.	957.	870.
7.	6.	908.	820.
8.	15.	1124.	1030.
8.	14.	1079.	980.
8.	13.	1035.	940.
8.	12.	1010.	920.
8.	11.	1044.	925.
8.	10.	1017.	920.
8.	9.	1021.	930.
8.	8.	1056.	940.
8.	7.	1013.	905.
8.	6.	1003.	880.
8.	5.	947.	845.
9.	15.	1094.	1000.
9.	14.	1044.	940.
9.	13.	1055.	950.
9.	12.	1061.	970.
9.	11.	1065.	970.
9.	10.	1048.	940.
9.	9.	1068.	970.
9.	8.	1079.	980.
9.	7.	1049.	955.
9.	6.	980.	930.
9.	5.	987.	895.

10.	15.	1087.	1000.
10.	14.	1073.	1000.
10.	13.	1124.	1020.
10.	12.	1109.	1010.
10.	11.	1069.	965.
10.	10.	1060.	980.
10.	9.	1090.	1005.
10.	8.	1097.	1000.
10.	7.	1054.	985.
10.	6.	1027.	950.
10.	5.	979.	905.
10.	4.	995.	875.
10.	3.	910.	820.
11.	22.	1195.	1160.
11.	21.	1155.	1120.
11.	20.	1155.	1120.
11.	19.	1155.	1120.
11.	16.	1171.	1060.
11.	15.	1173.	1060.
11.	14.	1117.	1045.
11.	13.	1108.	1030.
11.	12.	1118.	1000.
11.	11.	1063.	990.
11.	10.	1126.	1025.
11.	9.	1118.	1035.
11.	8.	1120.	1015.
11.	7.	1087.	990.
11.	6.	1052.	950.
11.	5.	1005.	925.
11.	4.	987.	895.
11.	3.	932.	835.
12.	22.	1175.	1140.
12.	21.	1135.	1100.
12.	20.	1105.	1070.
12.	19.	1115.	1080.
12.	18.	1130.	1095.
12.	17.	1140.	1090.
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12.	15.	1158.	1090.
12.	14.	1112.	1060.
12.	13.	1099.	1030.
12.	12.	1118.	1020.
12.	11.	1138.	1040.
12.	10.	1159.	1065.
12.	9.	1142.	1045.
12.	8.	1116.	1010.
12.	7.	1072.	970.
12.	6.	1010.	940.
12.	5.	1000.	910.
12.	4.	965.	880.
12.	3.	940.	845.
13.	22.	1155.	1120.
13.	21.	1125.	1090.
13.	20.	1152.	1060.
13.	19.	1065.	1030.
13.	18.	1122.	1060.
13.	17.	1120.	1075.
13.	16.	1151.	1085.
13.	15.	1150.	1100.
13.	14.	1202.	1090.
13.	13.	1170.	1065.
13.	12.	1134.	1069.
13.	11.	1182.	1085.
13.	10.	1176.	1070.
13.	9.	1140.	1045.
[illegible]	[illegible]	[illegible]	[illegible]

13.	7.	1079.	960.
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13.	5.	996.	920.
13.	4.	975.	860.
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14.	22.	1189.	1110.
14.	21.	1115.	1080.
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14.	13.	1195.	1090.
14.	12.	1153.	1090.
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14.	10.	1144.	1050.
14.	9.	1074.	1015.
14.	8.	1089.	985.
14.	7.	1061.	960.
14.	6.	1000.	915.
14.	5.	1008.	910.
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15.	17.	1089.	1000.
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15.	9.	1124.	1025.
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15.	7.	1057.	965.
15.	6.	1031.	950.
15.	5.	1031.	955.
15.	4.	1020.	950.
15.	3.	1010.	925.
15.	2.	971.	880.
15.	1.	902.	800.
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[illegible]	[illegible]	[illegible]	[illegible]

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16.	2.	1005.	910.
16.	1.	942.	840.
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17.	17.	1051.	950.
17.	16.	1080.	975.
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17.	14.	1085.	990.
17.	13.	1124.	1010.
17.	12.	1087.	990.
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17.	6.	1094.	1000.
17.	5.	1072.	980.
17.	4.	1066.	965.
17.	3.	1040.	950.
17.	2.	1011.	920.
17.	1.	913.	830.
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18.	18.	1044.	1000.
18.	17.	1089.	960.
18.	16.	1031.	935.
18.	15.	1045.	970.
18.	14.	1069.	970.
18.	13.	1068.	985.
18.	12.	1050.	960.
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18.	8.	1045.	1045.
18.	7.	1025.	1025.
18.	6.	1078.	1005.
18.	5.	1070.	965.
18.	4.	1056.	940.
18.	3.	1055.	925.
18.	2.	994.	900.
18.	1	909.	800.
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21.	15.	1057.	955.
21.	14.	996.	915.
21.	13.	966.	880.
21.	12.	1012.	910.
21.	11.	1051.	950.
21.	10.	1062.	755.
21.	9.	1051.	940.
21.	8.	960.	960.
21.	7.	965.	965.
21.	6.	982.	950.
21.	5.	1027.	935.
21.	4.	1005.	910.
21.	3.	974.	890.
21.	2.	962.	830.
22.	20.	1010.	1010.
22.	19.	1085.	1050.
22.	18.	1079.	1060.
22.	17.	1059.	1025.
22.	16.	1035.	1000.
22.	15.	994.	960.
22.	14.	1027.	920.
22.	13.	1033.	905.
22.	12.	959.	860.
22.	11.	1027.	920.
22.	10.	1016.	925.
22.	9.	993.	910.
22.	8.	1047.	940.
22.	7.	950.	950.
22.	6.	967.	930.
22.	5.	1015.	910.
22.	4.	979.	885.
22.	3.	914.	840.
23.	19.	1063.	1035.
23.	18.	1101.	1060.
23.	17.	1075.	1035.
23.	16.	1050.	1010.
23.	15.	1000.	980.
23.	14.	1046.	950.
23.	13.	1016.	925.
23.	12.	1002.	900.
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
23.	10.	995.	890.
23.	9.	1014.	905.
23.	8.	964.	930.
23.	7.	956.	930.
23.	6.	967.	920.
23.	5.	917.	880.
23.	4.	948.	850.
24.	19.	1053.	1010.
24.	18.	1045.	1045.
24.	17.	1082.	1035.
24.	16.	1058.	1010.
24.	15.	1020.	990.
24.	14.	1001.	965.
24.	13.	1026.	940.
24.	12.	1004.	920.
24.	11.	977.	870.
24.	10.	953.	860.
24.	9.	998.	890.
24.	8.	910.	910.
24.	7.	958.	910.
24.	6.	930.	880.
24.	5.	951.	850.
25.	19.	1024.	990.
25.	18.	1067.	1025.
25.	17.	1066.	1025.
25.	16.	1049.	1010.
25.	15.	1047.	995.
25.	14.	1009.	970.
25.	13.	1042.	950.
25.	12.	1022.	930.
25.	11.	977.	905.
25.	10.	945.	840.
25.	9.	955.	880.
25.	8.	890.	890.
25.	7.	870.	8[illegible]0.
25.	6.	925.	840.
26.	18.	1057.	1010.
26.	17.	1045.	1005.
26.	16.	1010.	980.
26.	15.	983.	970.
26.	14.	1006.	965.
26.	13.	996.	950.
26.	12.	965.	935.
26.	11.	1005.	920.
26.	10.	953.	870.
26.	9.	961.	845.
26.	8.	880.	880.
26.	7.	865.	865.
26.	6.	911.	820.
27.	18.	1020.	990.
27.	17.	1013.	985.
27.	16.	979.	955.
27.	15.	976.	940.
27.	14.	966.	940.
27.	13.	976.	940.
27.	12.	945.	920.
27.	11.	989.	900.
27.	10.	937.	860.
27.	9.	939.	840.
27.	8.	880.	880.
27.	7.	860.	860.
27.	6.	884.	800.
28.	19.	971.	945.
28.	18.	1009.	975.
28.	17.	983.	960.
[illegible]	[illegible]	[illegible]	[illegible]

28.	16.	1038.	940.
28.	15.	978.	900.
28.	14.	973.	910.
28.	13.	985.	910.
28.	12.	908.	890.
28.	11.	980.	870.
28.	10.	919.	830.
28.	9.	927.	840.
28.	8.	850.	850.
28.	7.	916.	840.
29.	20.	937.	890.
29.	19.	970.	930.
29.	18.	966.	950.
29.	17.	1007.	940.
29.	16.	989.	910.
29.	15.	956.	875.
29.	14.	931.	855.
29.	13.	929.	870.
29.	12.	916.	870.
29.	11.	943.	845.
29.	10.	902.	810.
29.	9.	911.	800.
29.	8.	800.	800.
30.	21.	900.	880.
30.	20.	934.	890.
30.	19.	951.	900.
30.	18.	1015.	920.
30.	17.	992.	905.
30.	16.	914.	850.
30.	15.	889.	830.
30.	14.	912.	840.
30.	13.	936.	845.
30.	12.	942.	850.
30.	11.	906.	810.
31.	21.	894.	820.
31.	20.	961.	880.
31.	19.	875.	820.
31.	18.	890.	810.
31.	17.	889.	800.
32.	21.	873.	800.
32.	20.	914.	830.

COMMAND?

```
COMMAND? list
    1.      //  JOB ,
    2.      // REGION=1024K,TIME=2
    3.      /*JOBPARM  LINES=10000
    4.      //  EXEC SURF2V,SIZE=512K
    5.      //SYSIN    DD  *
    6.      TITLE BARNABY CENTER
    7.      IDXY  431,11,3,1,2,3,-1,,,,'(F3.0,F5.0,F7.0)'
    8.      GRID  0,32,22,1
    9.      DEVICE  5,'LEWIS'
   10.      PERFORM
   11.      TRANSECT  1,15,0
   12.      SIZETRANSECT  8
   13.      STEREO  4,0,10
   14.      LINES  1,160,110
   15.      DISTANCE 50
   16.      ELEVATION 20
   17.      AZIMUTH  30
   18.      PERFORM
   19.      STOP
   20.      /*
   21.      //FT11F001  DD  *
```

Figure 8. Computer Program Used to Produce Figure 12

part of the J.C.L. Lines 6 through 18 make up the Surface II program used to generate one specific drawing. The program is comprised of a series of commands, many of which can be altered to change the drawing produced. A complete description of the Surface II program is contained in the book "SURFACE II Graphics System (REVISION ONE)" by R.J. Sampson of the Kansas Geological Survey. Figure 9 is a sample printout produced in this particular application of Surface II.

Lines 21 to the end of the program are the values from each data point and are entered in Fortran format. This formate can be specified in the IDXY command. In the example program in Figure 8, note that there are four columns of data but only three data fields specified in the Fortran format. This is designed so that, normally, the computer will read only the X,Y, and Z_1 values, and plot a drawing of the tree canopy. The Z_2 values are ingored. By deleting the Z_1 values of areas to be clearcut, the Z_2 values move into the data field that is read by the computer and the drawing produced will show the tree canopy in all areas except those cut, where it will show the ground. By manipulating the data in various ways and using the appropriate commands, the study area can be viewed from any angle, at any height, from any distance outside the area, with any number and combination of clearcuts. The resulting drawing can be any size up to the limits of the plotting device and can be viewed in either mono or stereo. For stereo viewing, the computer automatically prints two drawings, one rotated slightly, to produce the stereo effect when observed through a stereoscope.

```
J E S 2   J O B   L O G  --  S Y S T E M   I R C C  --  N O D E   O H S T M V S A

16.26.32 JOB 3187  $ TS030097 STARTED - INIT  3 - CLASS F - SYS IRCC
16.26.35 JOB 3187  +IEV005I - *SORT*  (BLKSIZE=6420)
16.37.15 JOB 3187  $ TS030097 ENDED

------ JES2 JOB STATISTICS ------

 24 APR 84 JOB EXECUTION DATE

      452 CARDS READ

    2,031 SYSOUT PRINT RECORDS

        0 SYSOUT PUNCH RECORDS

    10.72 MINUTES EXECUTION TIME

    1     //TS030097 JOB 'XXXXXXXXXXXXXXXX','TS0300',                          JOB 3187
          // REGION=1024K,TIME=2                                                     2.
          ***JOBPARM  LINES=10000                                                    3.
    2     //  EXEC SURF2V,SIZE=512K                                                  4.
    3     XXSURF2V   PROC SIZE=40K                                             00000010
    4     XXGO       EXEC PGM=SURF2V,PARM=&SIZE.                               00000020
    5     XXSTEPLIB   DD  DSN=SYS1.PLOTLIB,DISP=SHR                            00000030
    6     XXFT01F001 DD   UNIT=SYSVIO,SPACE=(CYL,(1,1)),                       00000040
          XX              DCB=(RECFM=VBS,LRECL=X,BLKSIZE=4096,BUFNO=1)         00000050
    7     XXFT02F001 DD   UNIT=SYSVIO,SPACE=(CYL,(1,1)),DCB=*.FT01F001         00000060
    8     XXFT03F001 DD   UNIT=SYSVIO,SPACE=(CYL,(1,1)),DCB=*.FT01F001         00000070
    9     XXFT04F001 DD   SYSOUT=A,DCB=(RECFM=FA,BLKSIZE=133,BUFNO=1)          00000080
   10     XXFT05F001 DD   DDNAME=SYSIN,DCB=BUFNO=1                             00000090
   11     XXFT06F001 DD   SYSOUT=A,DCB=(RECFM=FA,BUFNO=1)                      00000100
   12     XXFT08F001 DD   SYSOUT=B,DCB=BUFNO=1                                 00000110
   13     XXFT15F001 DD   DSN=SYS4.CONTROL(SURF2V),DISP=SHR,LABEL=(,,,IN),     00000120
          XX              DCB=BUFNO=1                                          00000130
   14     XXPLOTLOG   DD  SYSOUT=A,DCB=BUFNO=1                                 00000140
   15     XXVECTR1    DD  DSN=&&VECTR1,UNIT=SYSVIO,SPACE=(TRK,(1,1)),          00000150
          XX              DISP=(,PASS),DCB=BUFNO=1                             00000160
   16     XXVECTR2    DD  DSN=&&VECTR2,UNIT=SYSDA,SPACE=(CYL,(1,1)),           00000170
          XX              DISP=(,PASS),DCB=(BLKSIZE=6420,BUFNO=1)              00000180
   17     //SYSIN     DD  *                                                          5.
   18     //FT11F001  DD  *                                                         21.
   19     XXSORT     EXEC PGM=SORT,PARM='CORE=MAX,NOLIST,MSG=CP'               00000190
   20     XXSYSOUT    DD  SYSOUT=A                                             00000200
   21     XXSYSIN     DD  DSN=SYS4.CONTROL(PLOTCV2),DISP=SHR                   00000210
   22     XXSORTLIB   DD  DSN=SYS1.SORTLIB,DISP=SHR                            00000220
   23     XXSORTIN    DD  DSN=&&VECTR2,DISP=(OLD,DELETE)                       00000230
   24     XXSORTOUT   DD  DSN=&&SECTR2,DISP=(NEW,PASS),UNIT=SYSDA,             00000240
          XX              SPACE=(CYL,(1,1))                                    00000250
   25     XXSORTWK01 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000260
   26     XXSORTWK02 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000270
   27     XXSORTWK03 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000280
   28     XXSORTWK04 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000290
   29     XXSORTWK05 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000300
   30     XXSORTWK06 DD   UNIT=SYSDA,SPACE=(CYL,(5),,CONTIG)                   00000310
   31     XXPLOT     EXEC PGM=IEVSORT                                          00000320
```

Figure 9. Sample Printout Used to Produce Figure 17

```
32       XXSTEPLIB   DD   DSN=SYS1.PLOTLIB,DISP=SHR                                   00000330
33       XXPLOTLOG   DD   SYSOUT=A                                                    00000340
34       XXVECTR1    DD   DSN=&&VECTR1,DISP=(OLD,DELETE)                              00000350
35       XXVECTR2    DD   DSN=&&SECTR2,DISP=(OLD,DELETE)                              00000360
36       XXVECTTAPE DD    DUMMY                                                       00000370
37       XXSYSRASTR DD    DUMMY                                                       00000380
38       XXRASTTAPE DD    DUMMY                                                       00000390
39       XXSYSVECTR DD    SYSOUT=A,DEST=PLOT11                                        00000400


 STMT NO. MESSAGE
-
    4       IEF653I SUBSTITUTION JCL - PGM=SURF2V,PARM=512K
IEF236I ALLOC. FOR TS030097 GO
IEF237I 548   ALLOCATED TO STEPLIB
IEF237I VIO   ALLOCATED TO FT01F001
IEF237I VIO   ALLOCATED TO FT02F001
IEF237I VIO   ALLOCATED TO FT03F001
IEF237I JES2 ALLOCATED TO FT04F001
IEF237I JES2 ALLOCATED TO FT05F001
IEF237I JES2 ALLOCATED TO FT06F001
IEF237I JES2 ALLOCATED TO FT08F001
IEF237I 548   ALLOCATED TO FT15F001
IEF237I 548   ALLOCATED TO SYS00362
IEF237I JES2 ALLOCATED TO PLOTLOG
IEF237I VIO   ALLOCATED TO VECTR1
IEF237I 250   ALLOCATED TO VECTR2
IEF237I JES2 ALLOCATED TO FT11F001
IEF142I TS030097 GO - STEP WAS EXECUTED - COND CODE 0000
IEF285I    SYS1.PLOTLIB                                       KEPT
IEF285I    VOL SER NOS= IRCC72.
IEF285I    SYS84115.T162632.RA000.TS030097.R0000001           DELETED
IEF285I    SYS84115.T162632.RA000.TS030097.R0000002           DELETED
IEF285I    SYS84115.T162632.RA000.TS030097.R0000003           DELETED
IEF285I    JES2.JOB03187.SO0103                               SYSOUT
IEF285I    JES2.JOB03187.SI0101                               SYSIN
IEF285I    JES2.JOB03187.SO0104                               SYSOUT
IEF285I    JES2.JOB03187.SO0105                               SYSOUT
IEF285I    SYS4.CONTROL                                       KEPT
IEF285I    VOL SER NOS= IRCC72.
IEF285I    SYSCTLG.VIRCC72                                    KEPT
IEF285I    VOL SER NOS= IRCC72.
IEF285I    JES2.JOB03187.SO0106                               SYSOUT
IEF285I    SYS84115.T162632.RA000.TS030097.VECTR1             PASSED
IEF285I    SYS84115.T162632.RA000.TS030097.VECTR2             PASSED
IEF285I    VOL SER NOS= IRCC75.
IEF285I    JES2.JOB03187.SI0102                               SYSIN
IEF373I STEP /GO      / START 84115.1626
IEF374I STEP /GO      / STOP  84115.1636 CPU    1MIN 33.17SEC SRB    0MIN 00.04SEC VIRT  1024K SYS   366K
DEF501I   SUMMARY FOR STEP  GO
   CPU TIME                                I/O                                      MOUNTABLE UNITS
 | 00:01:33.17 |     | CARD        445  PRINT        143  PUNCH          0 |     |      DISK  0       |
 |             |     | DISK        310                     TAPE          0 |     |      TAPE  0       |
IEF236I ALLOC. FOR TS030097 SORT
IEF237I JES2 ALLOCATED TO SYSOUT
IEF237I 548   ALLOCATED TO SYSIN
IEF237I 548   ALLOCATED TO SYS00364
IEF237I 548   ALLOCATED TO SORTLIB
IEF237I 250   ALLOCATED TO SORTIN
IEF237I C6B   ALLOCATED TO SORTOUT
IEF237I C6A   ALLOCATED TO SORTWK01
IEF237I 251   ALLOCATED TO SORTWK02
IEF237I 250   ALLOCATED TO SORTWK03
IEF237I C6A   ALLOCATED TO SORTWK04
IEF23     C6B   ALLOCATED TO SORTWK05
IEF23     250   ALLOCATED TO SORTWK06
```

```
IEF142I TS030097 SORT - STEP WAS EXECUTED - COND CODE 0000
IEF285I   JES2.JOB03187.SO0107                         SYSOUT
IEF285I   SYS4.CONTROL                                 KEPT
IEF285I   VOL SER NOS= IRCC72.
IEF285I   SYSCTLG.VIRCC72                              KEPT
IEF285I   VOL SER NOS= IRCC72.
IEF285I   SYS1.SORTLIB                                 KEPT
IEF285I   VOL SER NOS= IRCC72.
IEF285I   SYS84115.T162632.RA000.TS030097.VECTR2       DELETED
IEF285I   VOL SER NOS= IRCC75.
IEF285I   SYS84115.T162632.RA000.TS030097.SECTR2       PASSED
IEF285I   VOL SER NOS= IRCC86.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000004     DELETED
IEF285I   VOL SER NOS= IRCC85.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000005     DELETED
IEF285I   VOL SER NOS= IRCC76.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000006     DELETED
IEF285I   VOL SER NOS= IRCC75.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000007     DELETED
IEF285I   VOL SER NOS= IRCC85.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000008     DELETED
IEF285I   VOL SER NOS= IRCC86.
IEF285I   SYS84115.T162632.RA000.TS030097.R0000009     DELETED
IEF285I   VOL SER NOS= IRCC75.
IEF373I STEP /SORT    / START 84115.1636
IEF374I STEP /SORT    / STOP  84115.1637 CPU    0MIN 00.91SEC SRB    0MIN 00.02SEC VIRT  1024K SYS   284K
DEF501I   SUMMARY FOR STEP   SORT
 ___CPU TIME___   _____________________I/O_______________________    ___MOUNTABLE UNITS___
|  00:00:00.91  | |  CARD         0  PRINT          0  PUNCH     0 | |       DISK  0       |
|_______________| |__DISK_________9_______________TAPE__________0__| |_______TAPE__0_______|
IEF236I ALLOC. FOR TS030097 PLOT
IEF237I 548  ALLOCATED TO STEPLIB
IEF237I JES2 ALLOCATED TO PLOTLOG
IEF237I VIO  ALLOCATED TO VECTR1
IEF237I C6B  ALLOCATED TO VECTR2
IEF237I DMY  ALLOCATED TO VECTTAPE
IEF237I DMY  ALLOCATED TO SYSRASTR
IEF237I DMY  ALLOCATED TO RASTTAPE
IEF237I JES2 ALLOCATED TO SYSVECTR
IEF142I TS030097 PLOT - STEP WAS EXECUTED - COND CODE 0000
IEF285I   SYS1.PLOTLIB                                 KEPT
IEF285I   VOL SER NOS= IRCC72.
IEF285I   JES2.JOB03187.SO0108                         SYSOUT
IEF285I   SYS84115.T162632.RA000.TS030097.VECTR1       DELETED
IEF285I   SYS84115.T162632.RA000.TS030097.SECTR2       DELETED
IEF285I   VOL SER NOS= IRCC86.
IEF285I   JES2.JOB03187.SO0109                         SYSOUT
IEF373I STEP /PLOT    / START 84115.1637
IEF374I STEP /PLOT    / STOP  84115.1637 CPU    0MIN 00.53SEC SRB    0MIN 00.03SEC VIRT    64K SYS   368K
DEF501I   SUMMARY FOR STEP   PLOT
 ___CPU TIME___   _____________________I/O_______________________    ___MOUNTABLE UNITS___
|  00:00:00.53  | |  CARD         0  PRINT       1715  PUNCH     0 | |       DISK  0       |
|_______________| |__DISK________55_______________TAPE__________0__| |_______TAPE__0_______|
IEF375I  JOB /TS030097/ START 84115.1626
IEF376I  JOB /TS030097/ STOP  84115.1637 CPU    1MIN 34.61SEC SRB    0MIN 00.09SEC
DEF502I   SUMMARY FOR JOB   TS030097   16:37:15    84/115
 __CSU__   __CPU TIME___   ______________I/O_______________   _STEPS_   _MOUNTABLE UNITS_
|   56  | | 00:01:34.61 | | UNIT               DISK     374 | |   3   | |     DISK  0     |
|_______| |_____________| |_RECORD_____2310__TAPE________0_| |_______| |_____TAPE__0_____|
DEF210I CHARGES=        $21.28  ACCOUNT BALANCE=        $241.08
```

BARNABY CENTER DATE 4/24/84 TIME 16:26:35 PAGE 1

```
          ********** INPUT X-Y-Z DATA POINTS **********

          THE NUMBER OF INPUT VARIABLES IS      3

          X IS VARIABLE  1
          Y IS VARIABLE  2
          Z IS VARIABLE  3
          IDENT. WILL NOT BE SAVED
          NO VARIABLE SPECIFIED FOR MAP SYMBOL

          NO CHECK WILL BE MADE FOR MISSING DATA

          FORMAT OF DATA IS (F3.0,F5.0,F7.0)

          THE NUMBER OF DATA POINTS TO BE READ IS    431

          THE X-Y-Z DATA POINTS WILL BE READ FROM FILE  11

          NO SUBSET SPECIFIED

          **************************************************

          THE X-MINIMUM OF X-Y-Z DATA IS           1.00000000
          THE X-MAXIMUM OF X-Y-Z DATA IS           32.0000000

          THE Y-MINIMUM OF X-Y-Z DATA IS           1.00000000
          THE Y-MAXIMUM OF X-Y-Z DATA IS           22.0000000

          THE Z-MINIMUM OF X-Y-Z DATA IS           800.000000
          THE Z-MAXIMUM OF X-Y-Z DATA IS           1202.00000

            431 X-Y-Z DATA POINTS SAVED

          NO ROTATION OF AXIS
```

-31-

```
          ********** GRID GENERATION **********

          NUMBER OF X-Y-Z DATA POINTS IS    431

          THE X-MINIMUM OF X-Y-Z DATA IS          1.00000000
          THE X-MAXIMUM OF X-Y-Z DATA IS         32.0000000

          THE Y-MINIMUM OF X-Y-Z DATA IS          1.00000000
          THE Y-MAXIMUM OF X-Y-Z DATA IS         22.0000000

          THE Z-MINIMUM OF X-Y-Z DATA IS        800.000000
          THE Z-MAXIMUM OF X-Y-Z DATA IS       1202.00000

          NO X-Y-Z DATA POINTS FOUND OUTSIDE EXTREMES OF GRID MATRIX

          ***** GRID MATRIX PARAMETERS *****

 ******** EXTREMES COMMAND NOT GIVEN --- MIN-MAX OF X-Y-Z DATA WILL BE USED

          THE X-VALUE AT LEFT   EDGE OF GRID MATRIX IS          0.69000006
          THE X-VALUE AT RIGHT  EDGE OF GRID MATRIX IS         32.3099976

          THE Y-VALUE AT BOTTOM EDGE OF GRID MATRIX IS          0.79000002
          THE Y-VALUE AT TOP    EDGE OF GRID MATRIX IS         22.2099915

          THE GRID MATRIX WILL HAVE    32 COLUMNS AND    22 ROWS

          THE DISTANCE BETWEEN COLUMNS IS                1.02000
          THE DISTANCE BETWEEN ROWS IS                   1.02000

          SAMPLE DATA POINTS WILL BE RETAINED

          DUPLICATE DATA POINTS WILL BE AVERAGED

          NO DUPLICATE DATA POINTS FOUND

            431 X-Y-Z DATA POINTS WILL BE USED TO CALCULATE THE GRID MATRIX

          THE GRID NODES WILL BE CALCULATED USING A WEIGHTED PROJECTION OF THE NEAREST DATA POINTS

          SCALED INVERSE DISTANCE SQUARED WILL BE USED FOR THE WEIGHTING FUNCTION
```

```
      ****** SEARCH METHOD FOR PHASE 1 OF GRID ******
******** NO SEARCH METHOD SPECIFIED, NEAR WILL BE USED
      ****** NEAREST NEIGHBOR SEARCH ******
      NUMBER OF NEAREST NEIGHBORS IS     8
      MAXIMUM DISTANCE TO NEAREST SAMPLE DATA POINT IS          2.82902431
      MAXIMUM SEARCH RADIUS IS           4.47307968
      ****** SEARCH METHOD FOR PHASE 2 OF GRID ******
******** NO SEARCH METHOD SPECIFIED, NEAR WILL BE USED
      ****** NEAREST NEIGHBOR SEARCH ******
      NUMBER OF NEAREST NEIGHBORS IS     8
      MAXIMUM DISTANCE TO NEAREST SAMPLE DATA POINT IS          2.82902431
      MAXIMUM SEARCH RADIUS IS           4.47307968
```

******** REGIONAL LINEAR TREND ********

STATISTICAL ANALYSIS

SUM OF SQUARES TOTAL ******	3017728.00
SUM OF SQUARES REGRESSION *	1139312.00
SUM OF SQUARES DEVIATION **	1878416.00
MEAN SQUARES REGRESSION ***	569656.000
MEAN SQUARES DEVIATION ****	4388.82031
GOODNESS OF FIT ***********	0.377540
MULTIPLE CORRELATION ******	0.614443
F TEST ********************	129.797058
FIRST DEGREE OF FREEDOM ***	2
SECOND DEGREE OF FREEDOM **	428

******** SOLUTION TO EQUATION ********

1013.94531	-5.266494	8.218533

```
****** TRANSECT PLOTTING PARAMETERS ******

EXTREME POINTS TO BE USED IN PLOTTING SURFACE
X = (      0.69,      32.31)     Y = (      0.79,      22.21)     Z = (    801.72,   1221.82)

THE Z-AXIS WILL BE SCALED TO   15.0 PERCENT OF MAXIMUM RANGE OF X AND Y

SCALE OF X AND Y ASSUMED TO BE EQUAL

PLOT WILL HAVE 160 COLUMNS AND 110 ROWS

MAXIMUM DIMENSION FOR PLOT IS      10.00 INCHES

ROTATION FROM SOUTH =    300.00 DEGREES

ELEVATION ABOVE THE HORIZON =       5.00 DEGREES

DISTANCE TO CENTER OF OBJECT =      50.00 MATRIX UNITS

****** STEREO PLOTTING PARAMETERS ******

STEREO ANGLE =         4.00 DEGREES

THE STEREO PAIRS WILL BE DRAWN TO BE VIEWED WITH A STEREOSCOPE

DISTANCE BETWEEN STEREO PAIRS IS      10.00 INCHES
```

```
***** SURFACE II COMMANDS AND ERROR REPORT *****   DATE  4/24/84  TIME 16:26:35     PAGE    1
--------------------------------------------------------------------------------------------------------

                    ****** COMMANDS ******

      (    1) 'TITLE BARNABY CENTER
      (    2) 'IDXY  431,11,3,1,2,3,-1,,,,'(F3.0,F5.0,F7.0)'
      (    3) 'GRID  0,32,22,1
      (    4) 'DEVICE  5,'LEWIS'
      (    5) 'PERFORM

      ***********************************************************************************

      START OF PLOTTING DEVICE     5

      ***********************************************************************************

                    ****** COMMANDS ******

      (    6) 'TRANSECT  1,15,0
      (    7) 'SIZTRANSECT 10
      (    8) 'STEREO  4,0,10
      (    9) 'LINES  1,160,110
      (   10) 'DISTANCE 50
      (   11) 'ELEVATION  5
      (   12) 'AZIMUTH  300
      (   13) 'PERFORM

                    ****** COMMANDS ******

      (   14) 'STOP
```

```
-----------------------------------------------------------------------------------------------

        ******** END OF SURFACE II EXECUTION ********

        NO WARNINGS AND/OR ERRORS FOUND DURING EXECUTION

        ***** WORDS AVAILABLE FOR DYNAMIC STORAGE ALLOCATION
        19712 (   15 PERCENT) WORDS USED BY PROGRAM

        ***********************************************************************************

        END OF PLOTTING - DEVICE     5 NUMBER OF PLOTS =      1

        ***********************************************************************************
```

```
VERSAPLOT V07.3                                                                 84.115  16:26:35

IEV005I - *SORT*  (BLKSIZE=6420)
                                          *****PLOT OPTIONS IN EFFECT*****

        MODEL=1200,   XMIN=0.0,  XMAX=1200.0,  YMIN=0.0,  YMAX=1200.0,   XSTART=0.0,  YSTART=0.0
        MODE=0,   MSGLVL=1,  MSGSW=0,   SCALE=1.0,   UNITS=1.0,   XFACT=1.0,  YFACT=1.0
        LYNES=200,   RESERV=0.0,   SPACE=4.0,  STRIP=10.56,  STRIPO=0.0,   LPAGE=54,  NDEC=2
        NIBS=2112,  DEN=200.0,  LBLK=8170,   ISCAN=264,  NSCAN=10,  NBAND=2736000,  NSTRIP=114
        IEND1=999,  IEND2=-999,  IEND3=23,  IEND4=-23

IEV010I - PLOT   1:     26,983 PLOTTABLE VECTORS,          0 CLIPPED VECTORS,          0 UNPLOTTABLE VECTORS
```

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VERSAPLOT V07.3 84.115 16:37:11

IEV0201 - INITIATING VECTOR MODE

IEV0801 - PLOT 1 COMPLETE, 26,983 VECTORS PROCESSED

Analysis of Results

The sample area used in this study was a section of the Barnaby Center located southeast of Lancaster, Ohio. The area is heavily wooded with small roads winding through somewhat hilly terrain. This is the type of area where large clearcuts, placed within the view of passing motorists, can be very aesthetically disturbing. To determine the effectiveness of using the Surface II program to visualize clearcuts, three sample clearcuts were programmed into the sample area outlined in the methodology section. The size and location of these cuts are displayed in Figure 10. This drawing represents the area as it would appear when viewed from an angle of 80° above the horizon and at an azimuth of 300° from the south. As you can see, not much can be distinguished, as far as relief features are concerned, at this elevation. From directly overhead, the drawing would appear as a grid with no distortion at all.

Figure 11 is a stereo pair of drawings representing the area as it would appear when viewed at an elevation of 20° and from an azimuth of 30° from the south. This pair of drawings has no clearcuts other than the clearings which actually exist at the Barnaby Center. The severe drop-offs at the far left and lower right corners are due to the fact that the data was not in the form of a rectangle. When there was no data for an area, the computer gave it the minimum value for the drawing, which in this case, was apporximately 800 feet above sea level. Although there were drop-offs in these areas, they were not as severe as they appear in the drawings. As noted in the methodology section, this can be prevented by using a rectangular shape for the study area.

The drawings in Figure 11 are 12 inches wide at their widest dimension. The rest of the drawings are 8 inches wide. There doesn't seem to be too much difference between a 12 and 8 inch drawing except that the 8 inch drawings

Figure 10. View at 80 elevation

BARNABY CENTER
PLOT NO. 1 DATE 4/24/84 TIME 16:34:52
AZIM = 300.0 ELEV = 80.0 DIST = 50

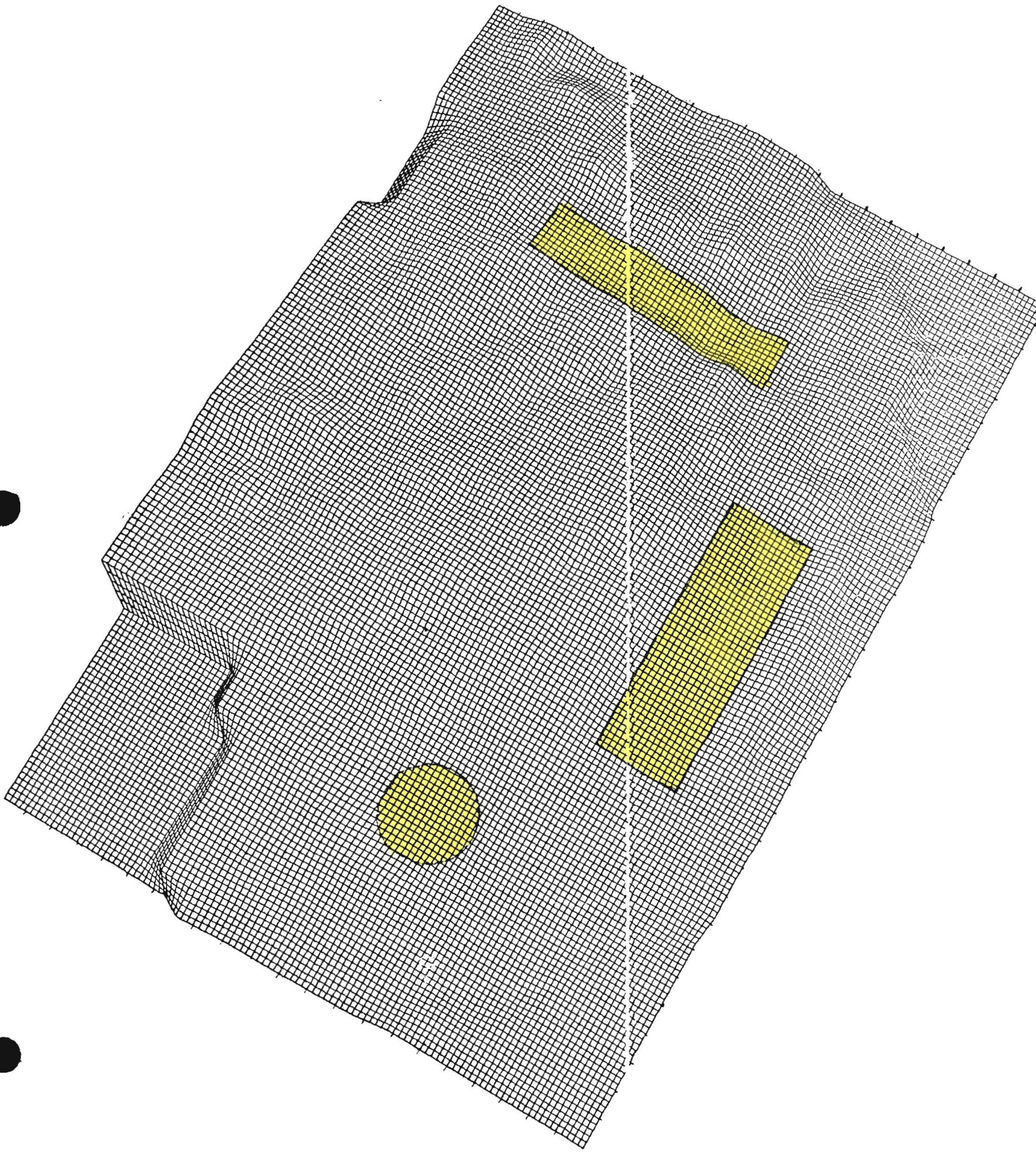
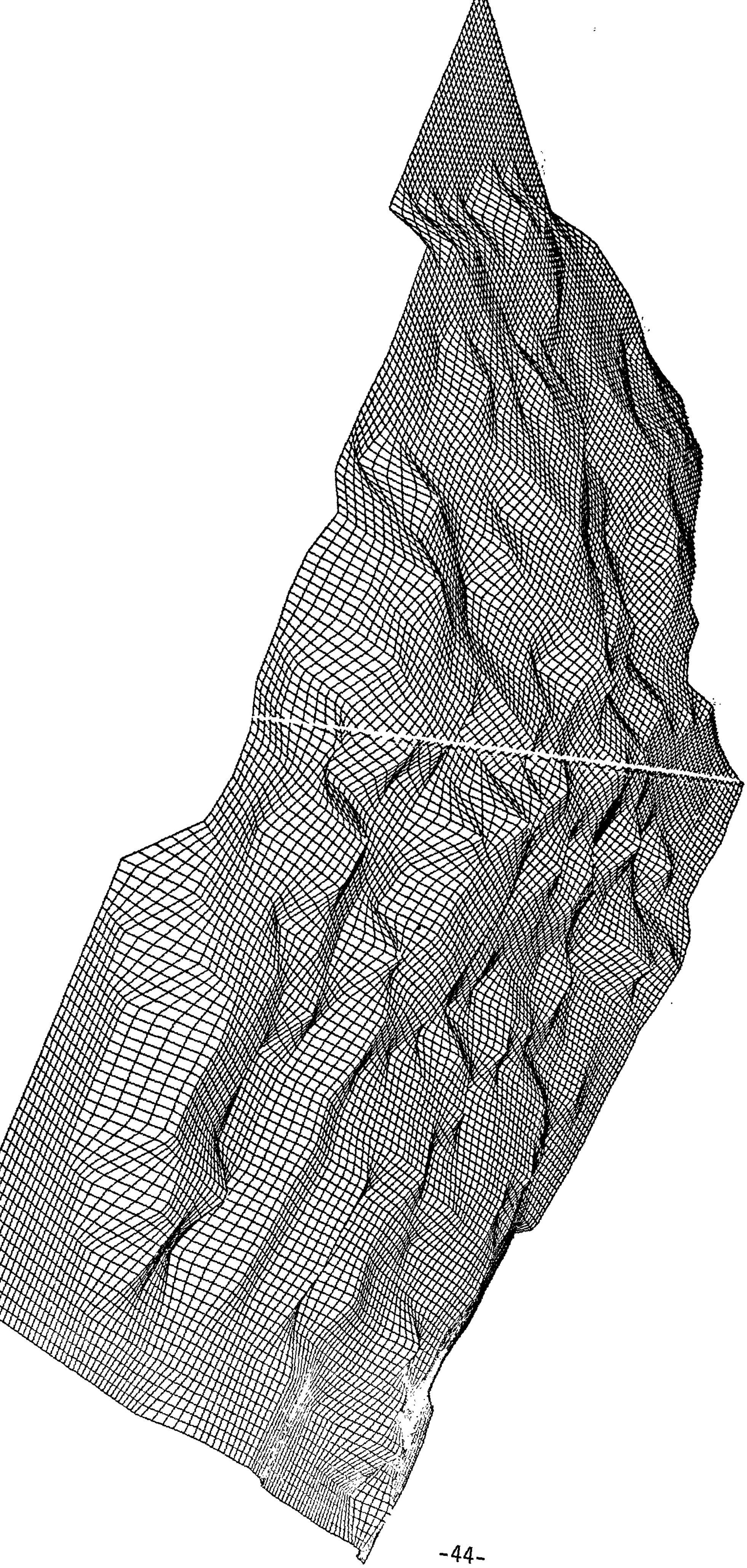
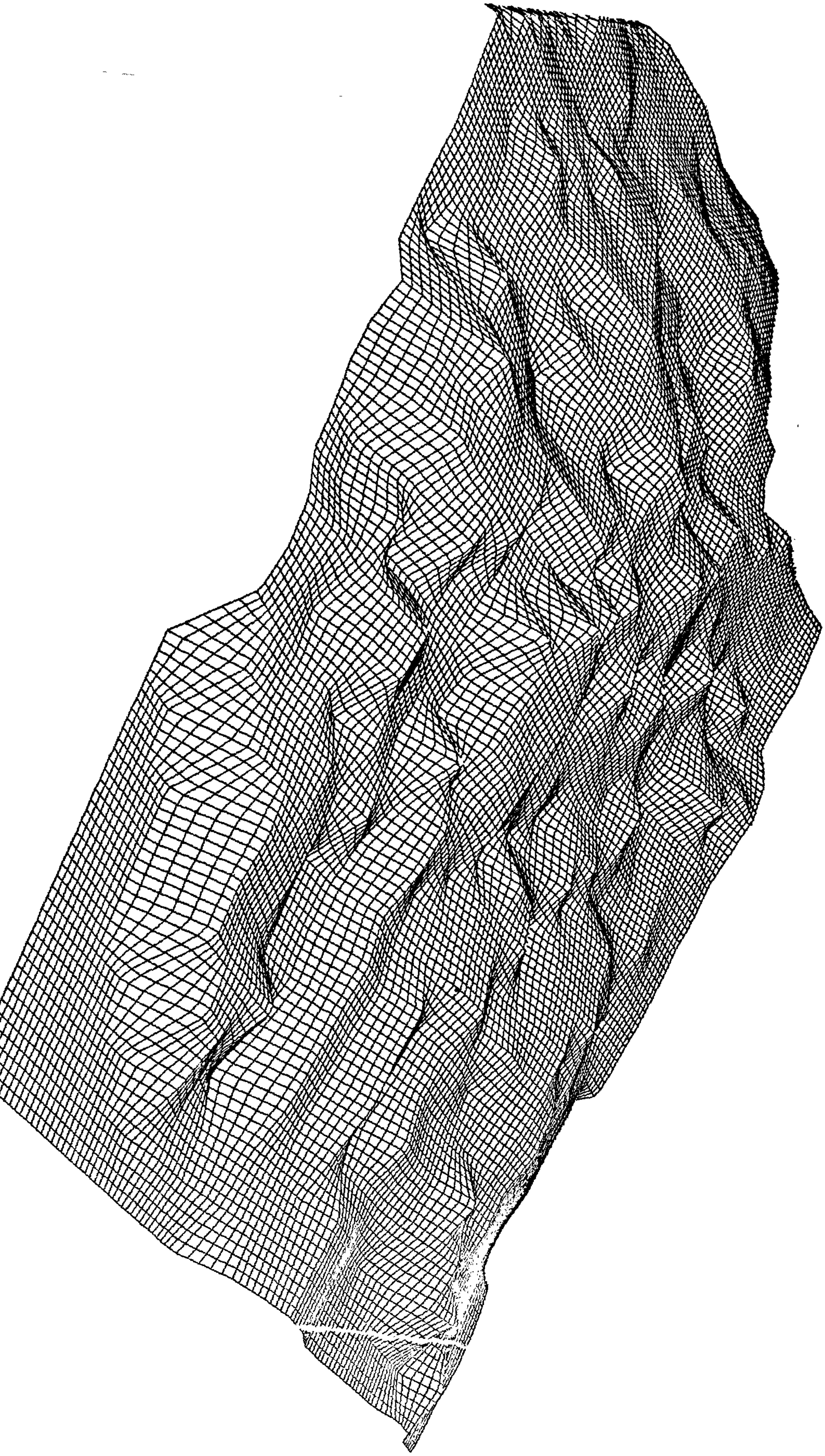


Figure 11. View at 30° azimuth without clearcuts

BARNABY CENTER
PLOT NO. 1 DATE 4/16/84 TIME 10:33:09
AZIM = 30.0 ELEV = 20.0 DIST = 50





appear a little darker because they have the same number of lines within a smaller space.

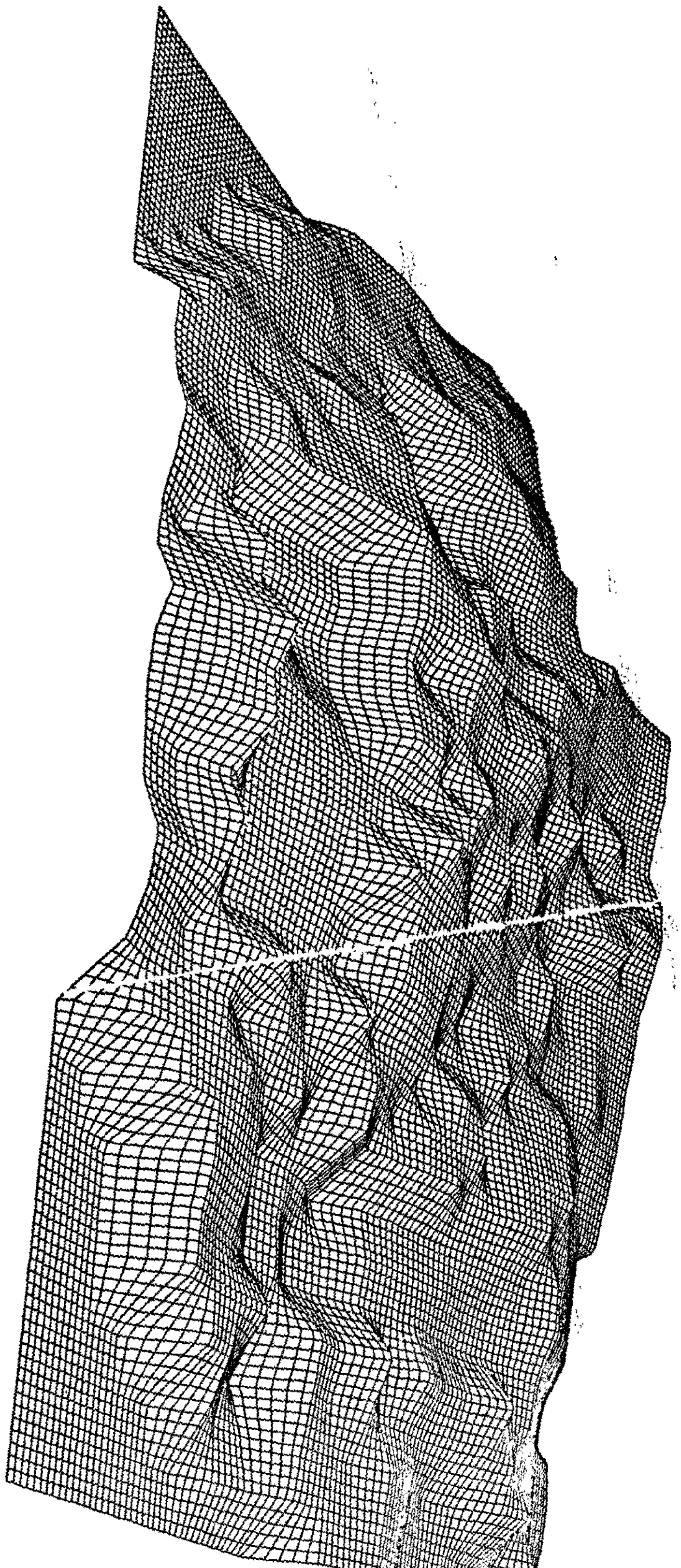
Figure 12 is the same area from the same vantage point, this time, however, with the three clearcuts programmed in. The two rectangular clearcuts show up particularly well with the circular cut being somewhat obscured by the vegetation between it and the viewer. At this elevation, it would be difficult to place a clearcut out of the view of an observer, but this is a very high elevation that wouldn't ordinarily occur. This view might be seen by someone looking down into a valley from a ridge.

Figure 13 is the same area viewed from an elevation of 10° above the horizon and at an azimuth of 120° from the south. Again, the severe drop-offs in the left and right corners, are due to the limits of the data. This drawing is at a more realistic elevation for an observer passing by on a road on another hill. The depression that can be seen running across the drawing is the draw that runs from the eight acre clearcut at the top of the area down to the clear creek which winds along the southern edge of the sample area.

The direction referred to as south in the azimuths of these drawings is actually slightly north of west on a topographic map. The computer labels azimuths from any origin specified and in this case the bottom or south face of the drawing is actually facing west.

In Figure 14, with the clearcuts inserted, the circular cut is totally hidden while each of the rectangular cuts are partially visible. The drawings would probably be more effective if the area of each cut could be shaded in to contrast with the uncut areas, but it would be very difficult to do this by hand as it was done on the view from 80° elevation. Many of the lines on these drawings are hidden or merged with others to make it impossible to locate the exact boundaries of the cut.

Figure 12. View at 30° azimuth with clearcuts



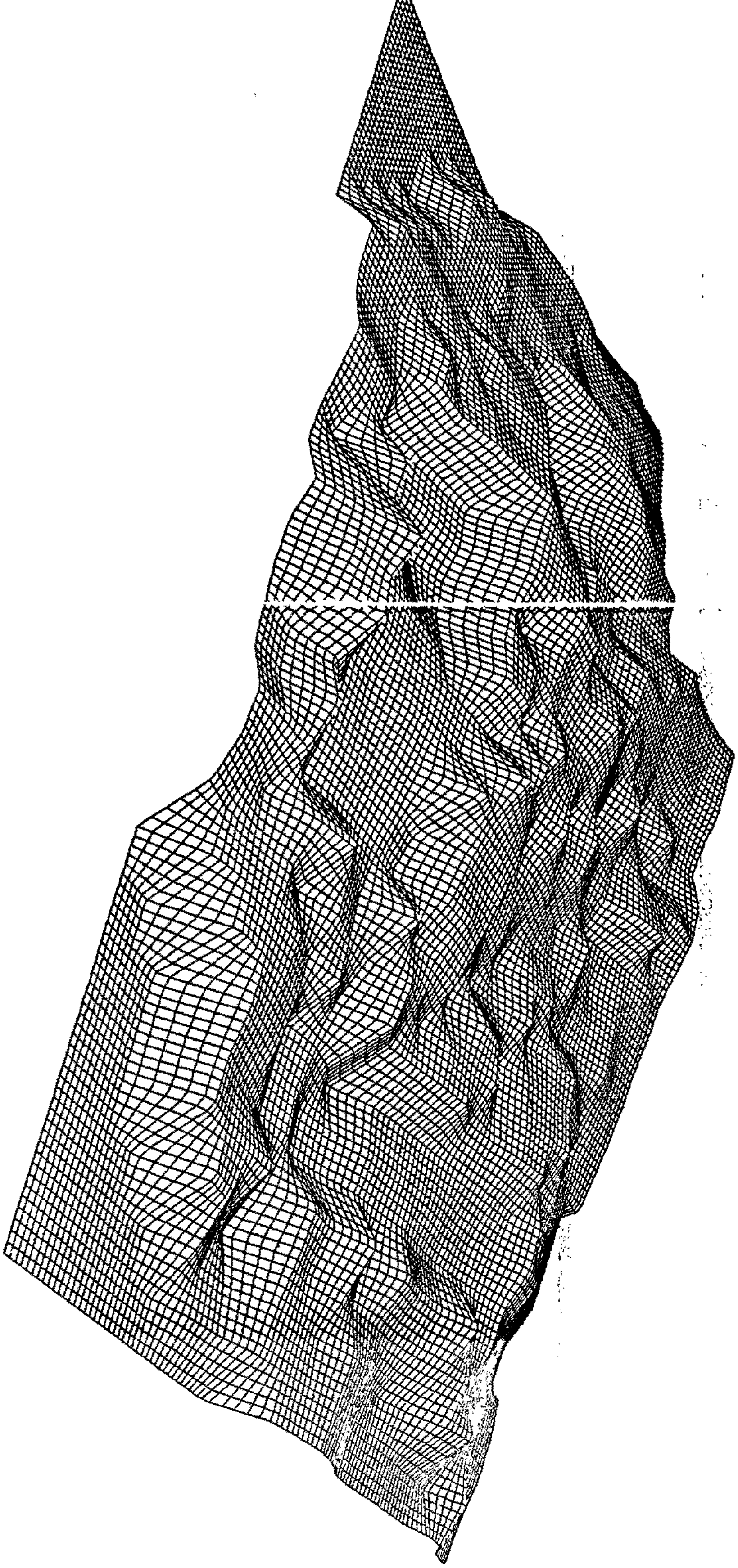
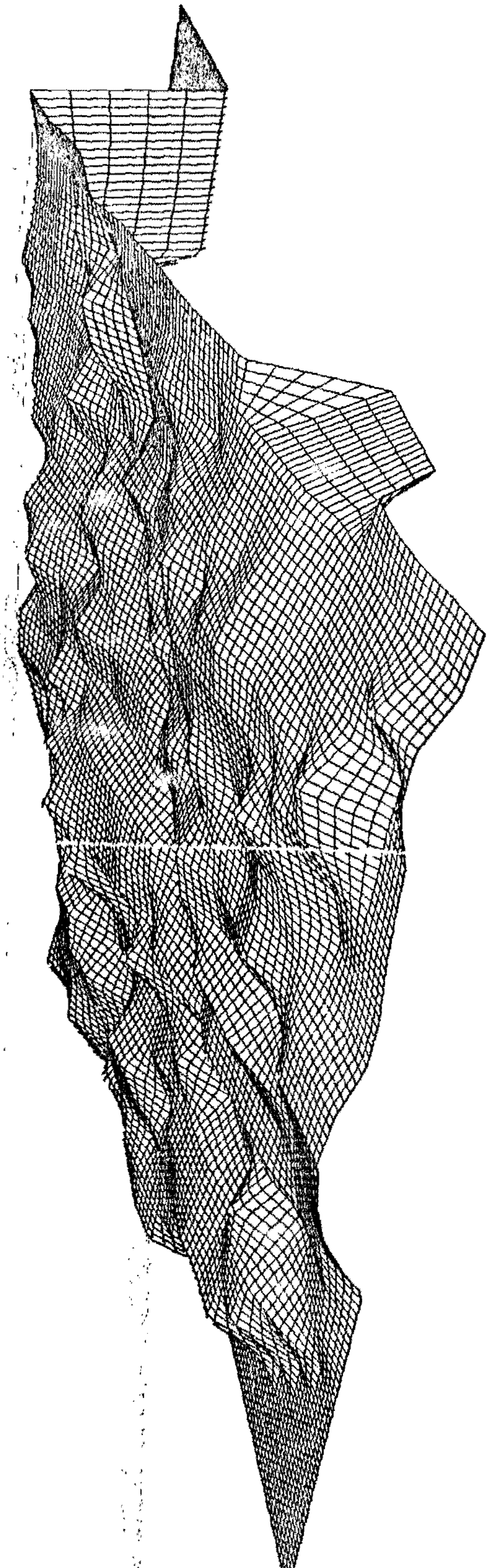


Figure 13. View at 120° azimuth without clearcuts

BARNABY CENTER
PLOT NO. 1 DATE 4/19/84 TIME 14:22:47
AZIM = 120.0 ELEV = 10.0 DIST = 50



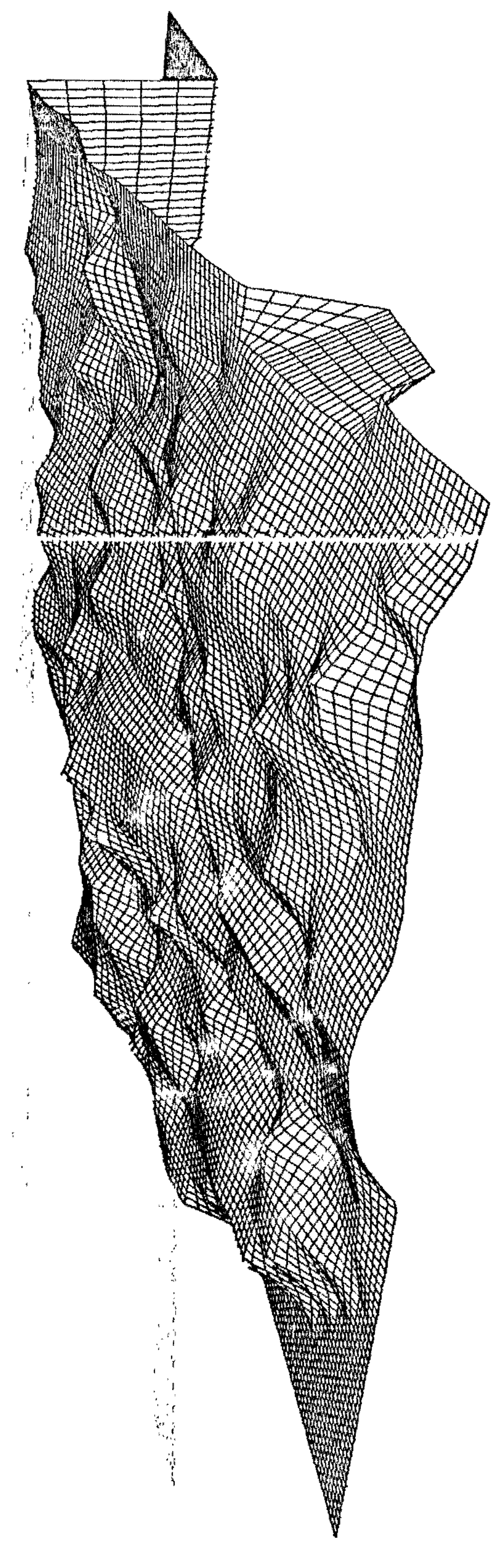
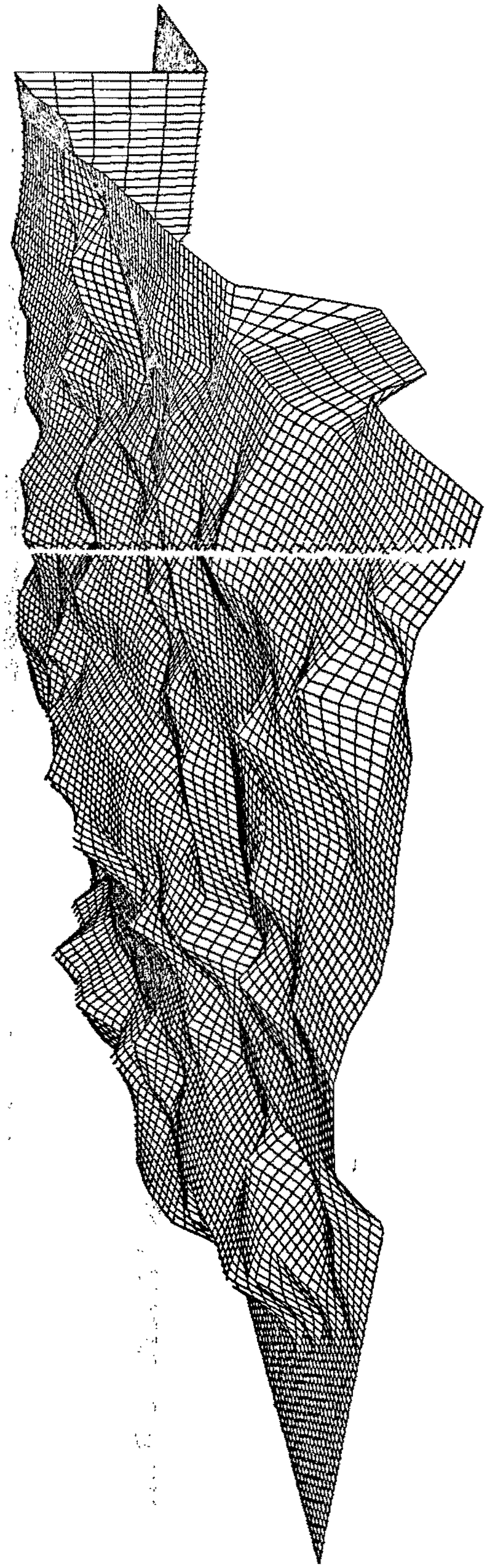
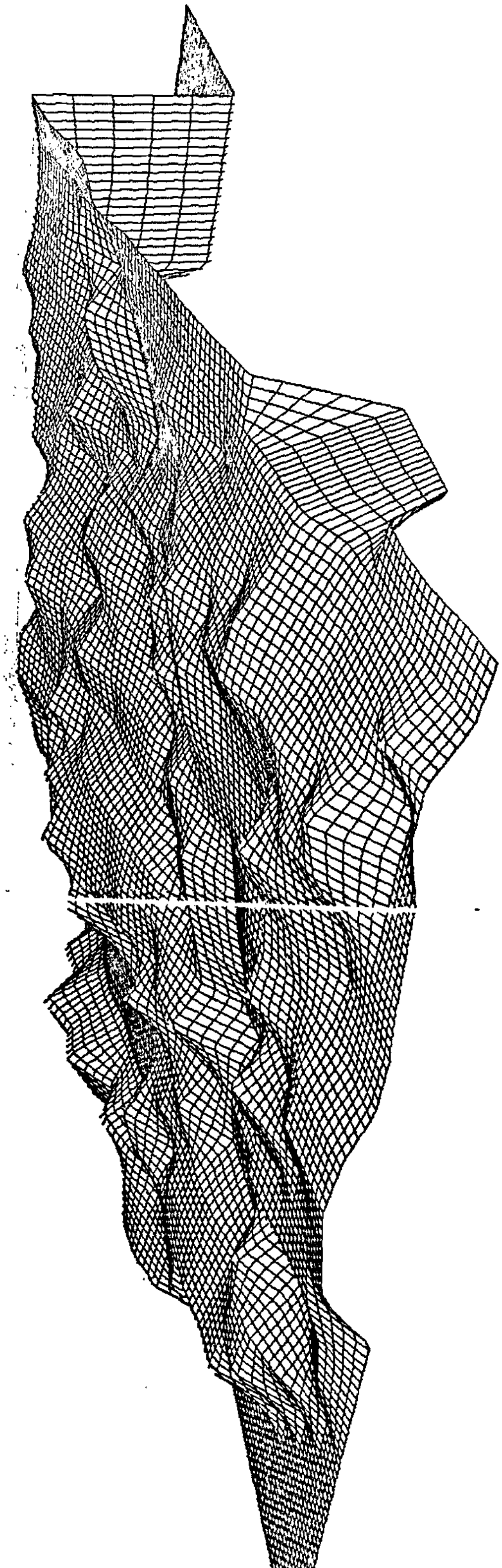


Figure 14. View at 120° azimuth with clearcuts





In Figures 15 and 16, the area is viewed from an elevation of 15° and at an azimuth of 210°. This vantage point is directly opposite of that in Figures 11 and 12. Only the circular clearcut shows up clearly in Figure 16 with the other two cuts being very well hidden. Although this elevation is higher than that in Figures 13 and 14, it appears to be lower. This is because the elevation is measured from a point at the center of the drawing and at the lowest valued used in the drawing, not from the surface of the drawing. Consequently, the vantage point seems lower in Figures 15 and 16. In relation to the surface of the study area it is actually lower.

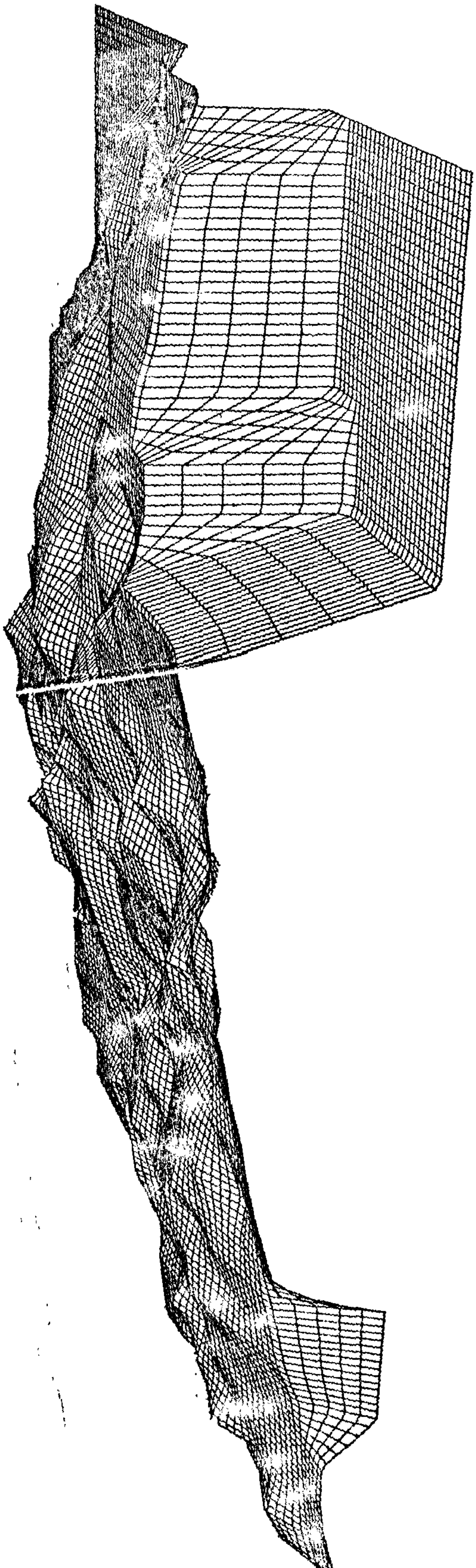
Finally, Figures 17 and 18 represent the view seen from an elevation of 5° and at an azimuth of 300°. Here, the circular clearcut can be seen almost perfectly while the larger of the two rectangular cuts is partially visible in the right side of the drawings. The other cut seems to be pretty well hidden from the view. This pair of figures appears the most realistic and effectively displays the potential of the Surface II system for illustrating the effects of clearcuts on the surrounding landscape without having to make the cuts first and suffer the consequences later.

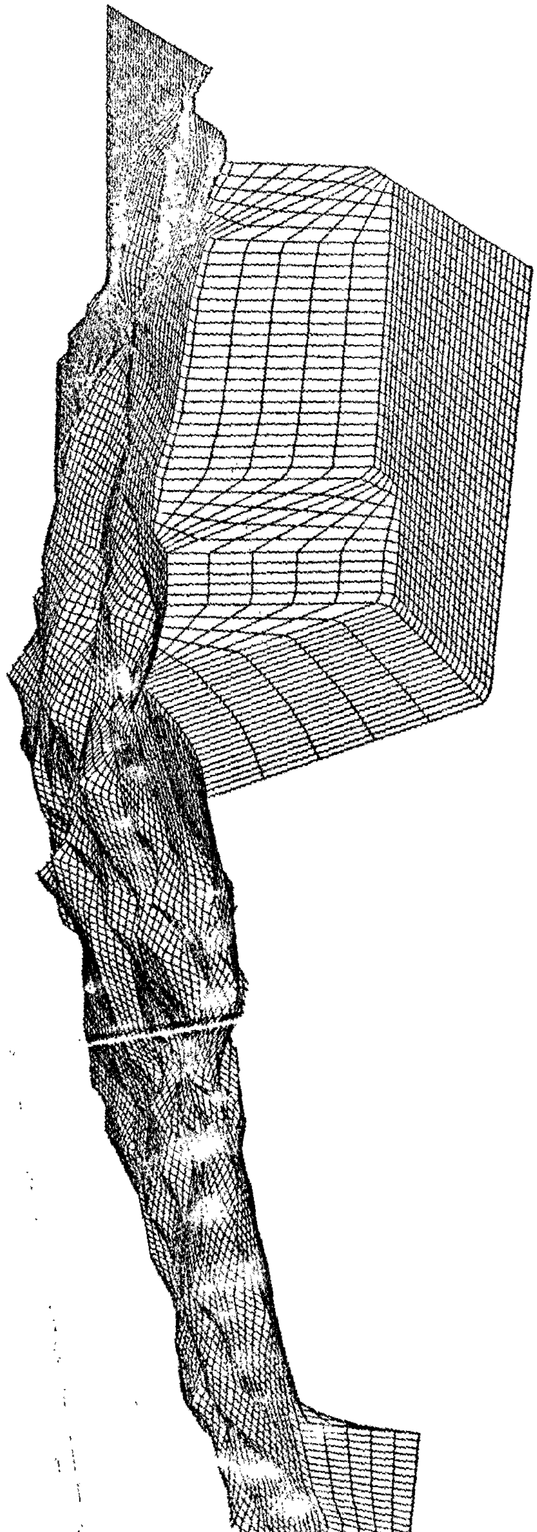
One of the problems with the system that I wasn't able to solve was the effect of the way the computer smooths the data in order to produce the smooth surfaces in the drawings. Because of this, it is difficult to get the effect of a vertical drop from the canopy to the ground at the edge of a cut. One solution might be to increase the number of data points around the edge of cut areas, but this would be very time consuming and would limit the verstility of the program. Another solution might be to increase the number of data points on the whole area which would be easier than changing only those around the cuts, but would also require more time to produce.

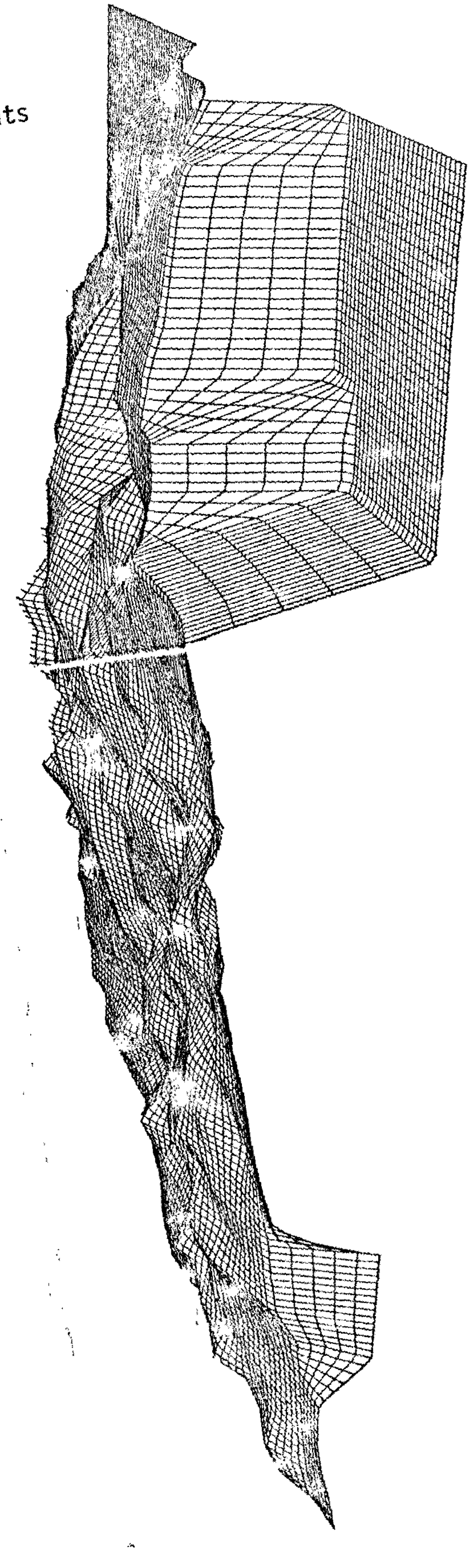
The other major problem, as mentioned earlier, is the fact that the

Figure 15. View at 210° azimuth without clearcuts

BARNABY CENTER
PLOT NO. 1 DATE 4/19/84 TIME 14:29:06
AZIM = 210.0 ELEV = 15.0 DIST = 50







igure 16. View at 210° azimuth with clearcuts

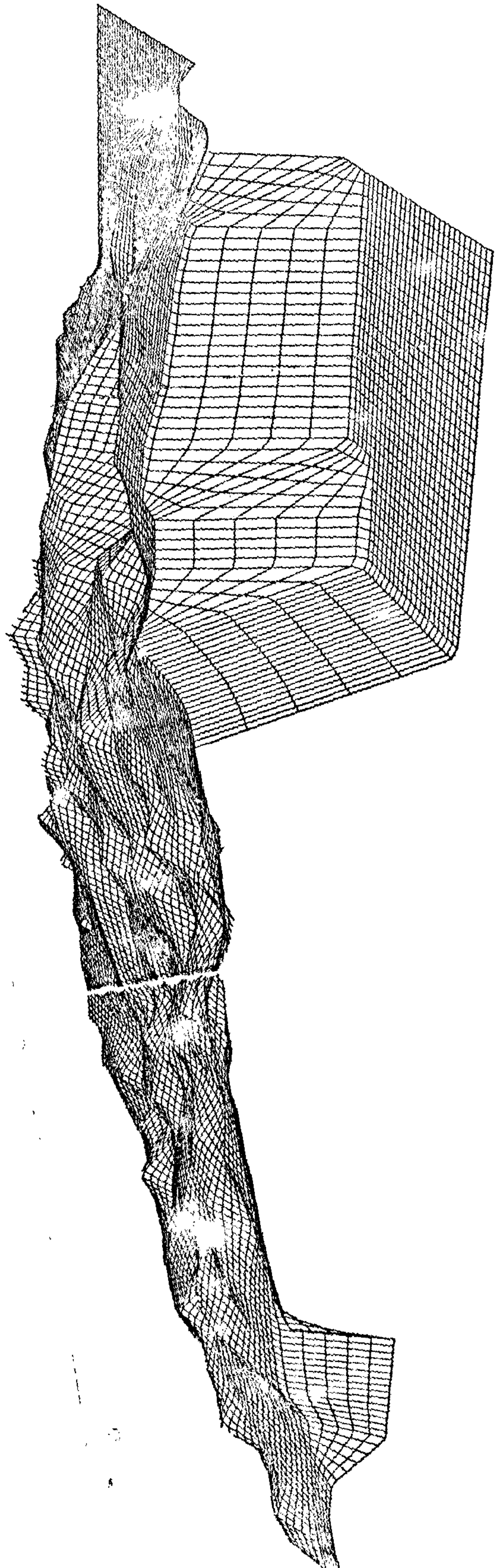
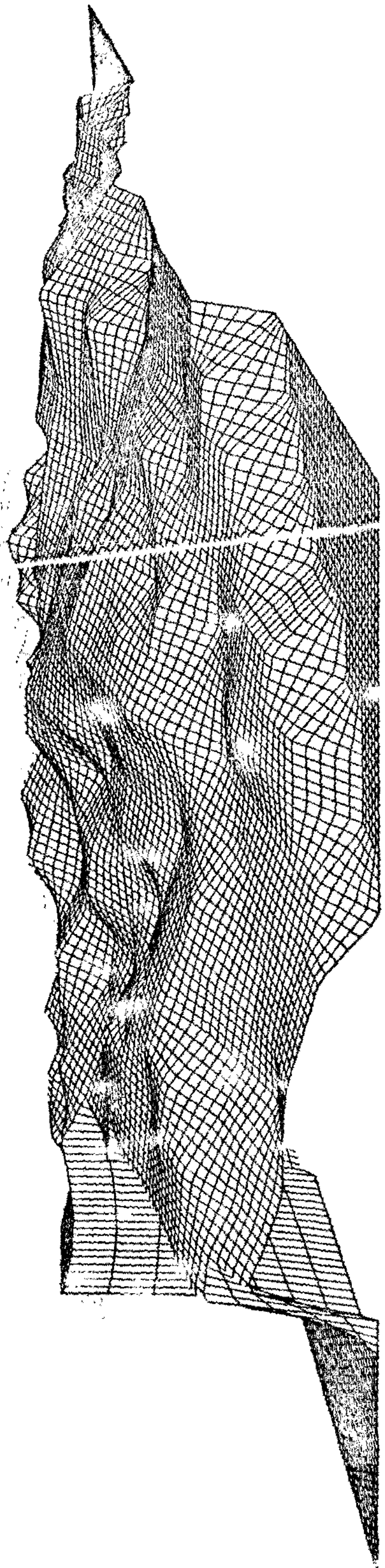


Figure 17. View at 300° azimuth without clearcuts

BARNABY CENTER
PLOT NO. 1 DATE 4/19/84 TIME 14:49:11
AZIM = 300.0 ELEV = 5.0 DIST = 50



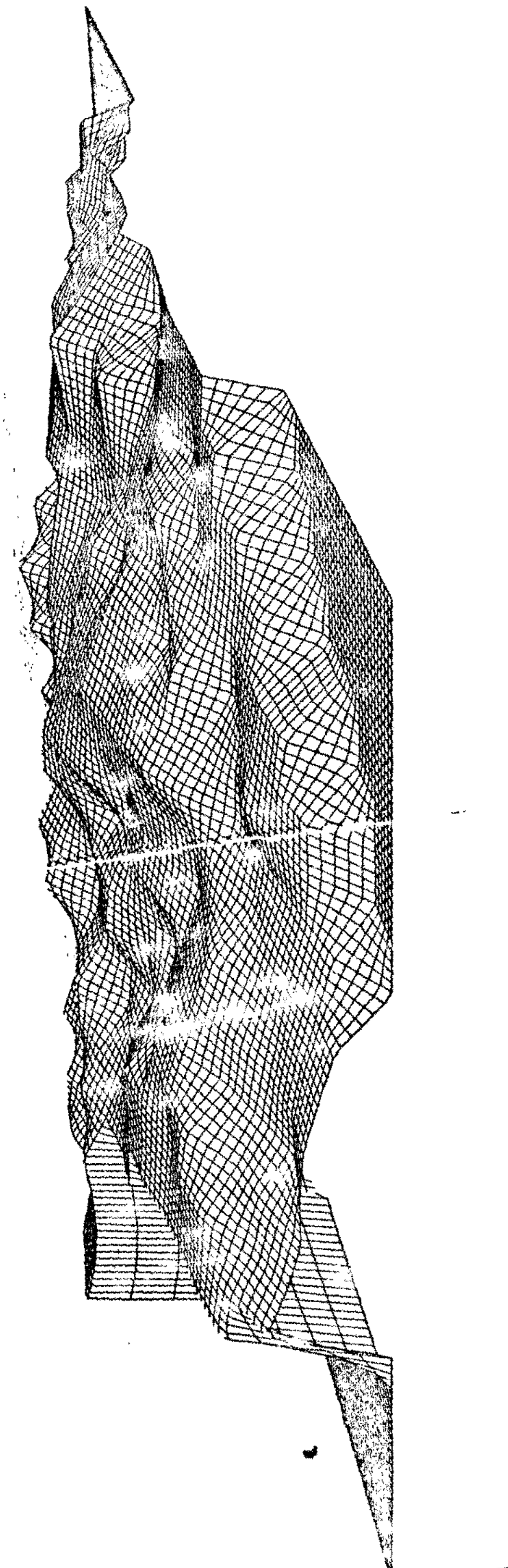
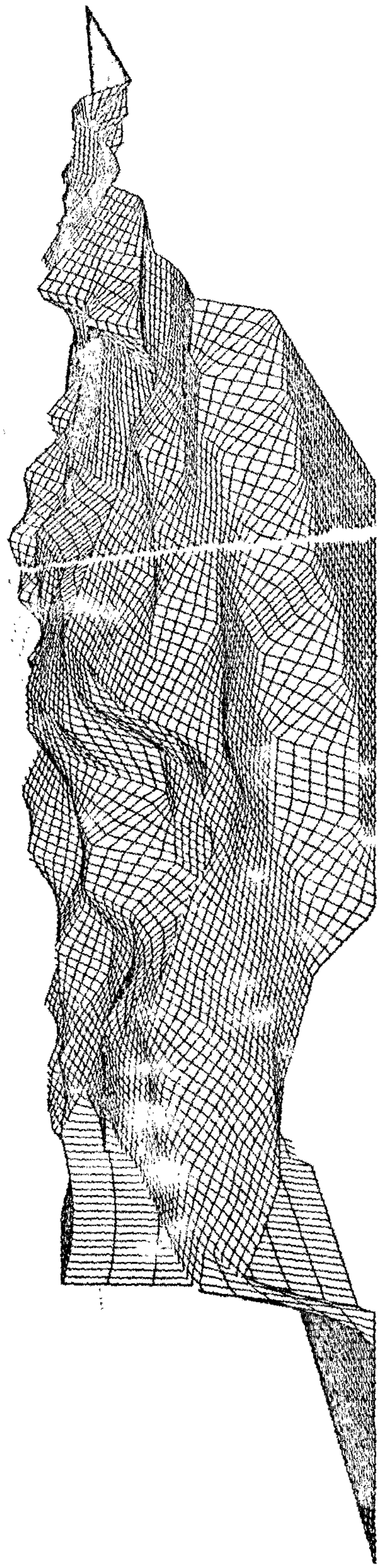
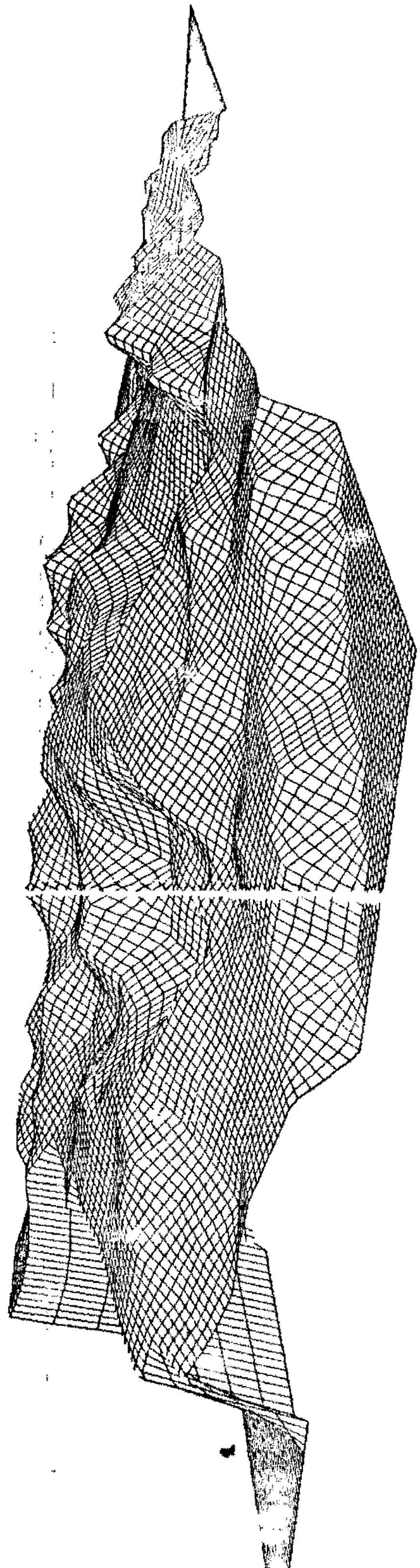


Figure 18. View at 300° azimuth with clearcuts





drawings are only one color. Due to the fact that these drawings are produced on a versatec plotter rather than a pen plotter, different colors within the drawing are probably not possible. If, however, the drawings could be generated using a pen plotter, perhaps two or more colors would be possible.

Overall, it seems that this is a fairly inexpensive method of producing drawings to illustrate what a clearcut will look like before it is actually performed. Access to a computer with the Surface II program is required and since this is a fairly complex program, that access may be somewhat difficult to obtain. Each set of drawings or stereo pair costs about twenty dollars to print on the versatec plotter, which is relatively inexpensive compared to the cost of obtaining and preparing the data necesssary to write the program.

Figure 19 is a list of the steps involved in producing the drawing such as those in Figures 10-18. It is basically a summary of the steps outlined in the methodology section of the study.

List of Steps

1. Identify Area.
2. Draw a base map.
3. Transfer outline of area to Aerial Photo.
4. Using stereo pair, differentiate areas according to tree height.
5. Transfer area boundaries to base map.
6. Lay out compass lines with measurement points at convenient intervals, eg. 100, 200, 300 feet.
7. Acquire measurement tools - hypsometer (haga), compass, 100ft tape, increment borer can be used if site index is desired.
8. Make field measurements by running compass lines and measuring a dominant or co-dominant tree at each point. Note height and species.
9. Get the average height and standard deviation for each area.
10. Photograph a topographic map of the area and enlarge to a workable size, 1:10,000.
11. Superimpose a grid in a random manner over the enlarged topo map.
12. Transfer the area boundaries onto the topo map.
13. Make a photocopy of the topo map with boundaries and grid.
14. Give X an Y coordinates to each grid intersection on the map.
15. Determine Z coordinates from topo map for each intersection.
16. Using random number table and formual generate tree heights for each x,y pair on the grid. These heights are based on the average heights measured earlier as well as the standard deviation of those measurements.
17. Add tree height measurement for each x,y pair to the topographic elevation for that point to obtain Z_1 value. Z_2 value is the ground elevation alone.
18. Type computer program including; data in fortran format and commands for viewing angle and stereo view.
19. By changing Z_1 values of clearcut areas to Z_2 values, clearcuts will be drawn into drawings.

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